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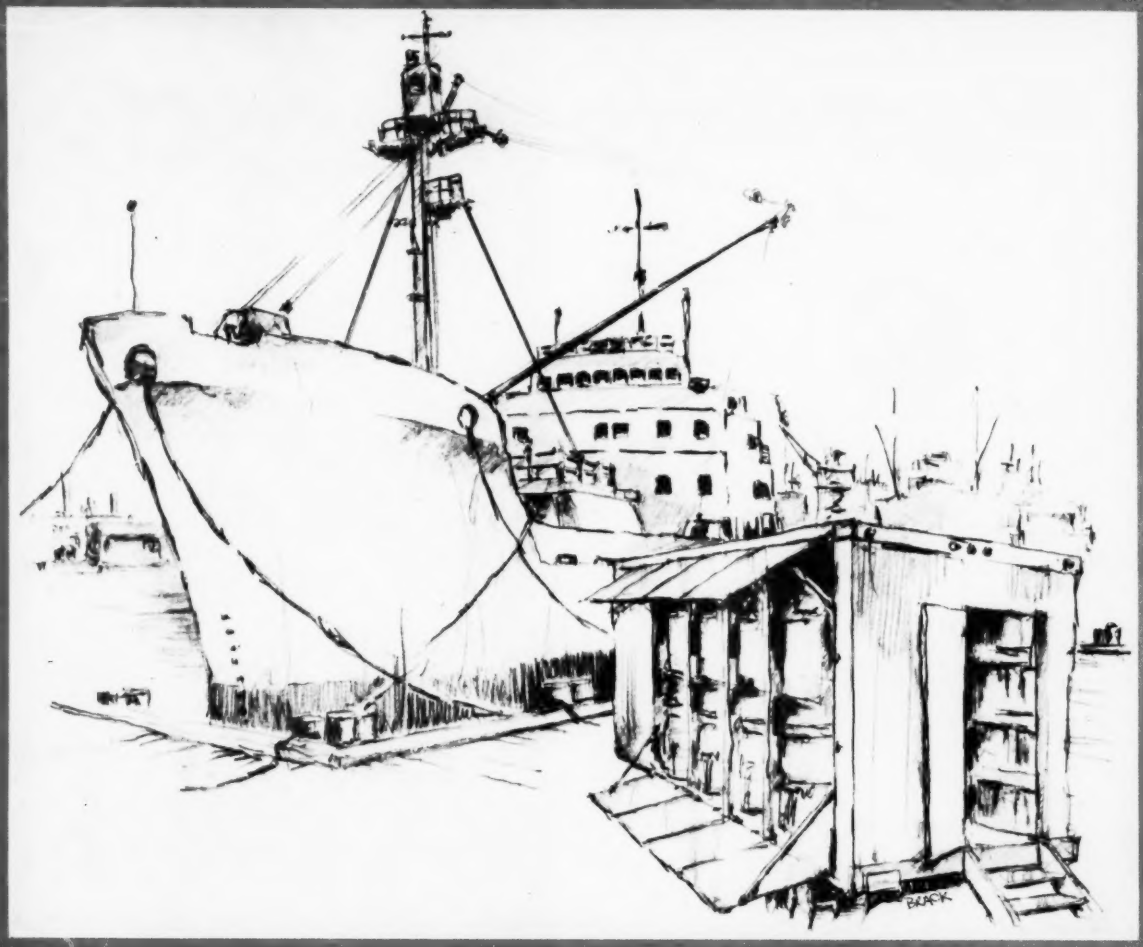
FALL 1973



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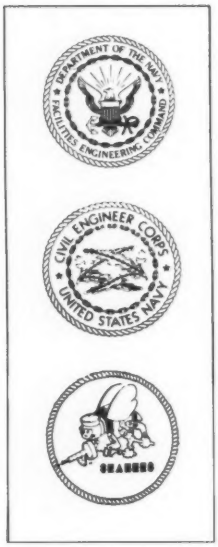

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CORRECTION

The Navy Civil Engineer incorrectly identified the author of the article "Navy Hospital Solid Waste Handling Systems" (Spring Edition 1973, p. 9) as Sherrill E. Smith. The author was actually *Floyd Hildebrand*. The publication's editorial staff regrets the error.

An energy diet will become cold reality this winter.

Navy Utilities Energy Conservation Program

By MILLARD E. CARR, PE
Utilities Division, NAVFAC

• Alexandria, Va.

The much publicized, long ignored energy crisis has dramatically forced itself on our attention. President Nixon, in his June 29 message to Congress, made it perfectly clear that "... the conservation of energy resources is not a proposal; it is a necessity. . . . it is particularly urgent that steps to encourage energy conservation begin at once."

Every ship in the fleet depends on steam and electricity for in-port service, communications, repair, replenishment — complete support. Everyone on naval shore bases relies directly on the utilities: heat and electricity are essential for us to do our jobs and live our everyday lives.

In the past we have all been able to expect these energy sources as a spoiled child expects to always be catered to. The cheap, always-available energy of the past has lulled us into a dangerous disinterest. If anything, we're rather annoyed to hear that we may have to go on an "energy diet." But the vague threats of energy shortages will become cold realities by this winter.

Utilities Fuel Use

The utilities system is the heart of the naval shore establishment, and fuel is the vital life-force needed to keep this heart pumping. During fiscal year '72 the 1,600 naval utilities systems used over 174,066,500,000,000 Btus of primary energy. This is equivalent to approximately seven million tons of coal (a chunk of coal a quarter of a mile square and eleven stories high.) In terms of actual specific fuels, this energy was derived from approximately 731,000 tons of coal, 710 million gallons of fuel oil and 48 billion cubic feet of natural gas. These figures are a little more meaningful, perhaps, if we realize that the naval shore establishment produced enough steam to heat over 2 million homes and used enough electricity to burn 8.5 million 100-watt light bulbs all year long.

As the ultimate products of this energy, the naval shore establishment uses approximately 50% for generating steam for both heating and process use; 37% for electricity, both purchased and self-generated; 12% as domestic natural gas and 1% for air compression. Of the total $284 million expended during FY 1972 for utility operation and maintenance, $126 million was spent for fuel, both directly and indirectly as commercial electrical energy.

Crisis Causes

All these figures simply give a quantitative feeling for the importance of the navy's utilities system and the extent of the potential problem. And the problem will not go away once all the new wells get drilled and those new supertankers get floating. The energy crisis has been building too long to go away overnight.

The reasons behind the impending crisis have been well-publicized and are becoming quite controversial. Exponential per-capita energy usage due to artificially-created standards of living; unnecessary inefficient appliances; lack of capital to develop replacement and reserve energy capacity; failure to recognize the problem in time to head it off; all have shared in the growth of the problem.

But some of the causes have been unavoidable. Zealous application of necessary and long-neglected ecological improvements has led to discontinuing the use of high-sulfur coal and oils and increased the use of natural gas. Now we find this gas is limited and becoming harder and more expensive to produce.

Concern with the environment has also halted earth-scarring strip-mining.

Nuclear power plant construction has been slowed for safety and environmental considerations.

Conventional power plants have been stalled for the installation of expensive anti-pollution control devices requiring long lead time.

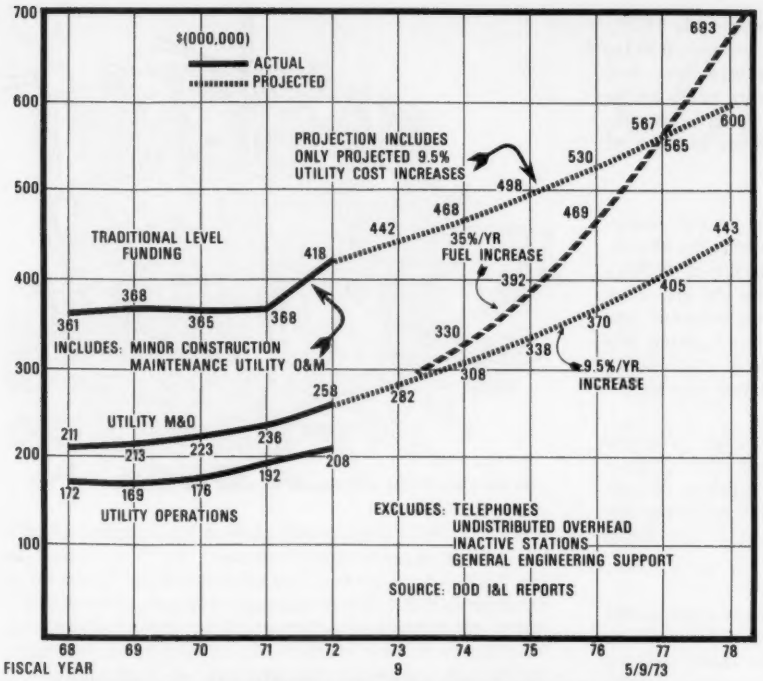
While these concerns are certainly valid and the need to take action long overdue, the net effect is that already-serious energy problems are compounded.

Navy's Energy Problems

Another major factor that multiplies the effects of the energy crisis in the navy is the poor condition of our $4.5 billion utilities systems. Just as a person can neglect the health of his heart until he suffers an attack, the health of the navy's utilities systems have been ignored. Over half of these systems, installed during the second World War, were constructed out of available materials and with less-than-optimum design. The majority are reaching the end of their useful life. Only 5% of the utilities plants are under 10 years old; a poor contrast with a ratio of 60% in similar commercial systems.

Other technical constraints have accelerated the decreasing capabilities of these systems. "Normal" utility load growth has resulted from increased standards of living, greater lighting levels, etc. Increases in utility service quality have been caused by the need for higher steam pressure and voltages to supply the nuclear fleet and required compatibility with more sophisticated commercial electrical services. These technical requirements, coupled with inflation and tough competition for the limited navy capital investment dollar, have steadily reduced the capability of the utility systems. They are limited in their ability to use different fuels. The efficiency with which the fuel is used and, as a consequence, their reliability and fleet support capability are also limited.

The ultimate solutions to the energy crisis are not just around the corner. The necessary anti-pollution devices and fuel preparation processes needed to enable us to use the high-sulfur coals and oils will require long development work and huge capital investment. The rapid technological development of the rest of the world is requiring a greater share of the earth's energy resources. As a result, political and economic factors will play a big role in foreign fuel importation. The national security implications of a large percentage of this nation's energy being supplied from abroad are obvious. Any new source of energy — such as magnetohydrodynamics, solar, geothermal, fusion, etc. — will face the same environmental restrictions and delays as those of today. These energy sources are also quite a bit



UTILITIES FUEL COST PRESSURES — ALL FUND SOURCES

Historical utility cost increases have killed "level funding." Estimated fuel cost increases threaten to initiate "vertical funding."

of research and development away from economical application.

We in the navy can expect the energy problem to be with us for quite a long time. But the problem is really two problems wrapped around each other.

Higher Fuel Costs

First, fuel and all things dependent on fuel will be increasingly expensive. The most universal common denominator for items in short supply is cost, and we have already seen the jet assisted takeoff of fuel prices. The rate of climb of the cost of commercial utilities is the most frightening indicator of things to come. Utility companies serving naval activities have already applied for rate increases up to 60%. These requests are almost always directly attributed to the higher cost of primary energy to the utility company, and it is expected that these increases will continue into the future.

Fuel is rapidly becoming the major factor in utilities costs. In FY '71, fuel accounted for 25% of the utilities O&M budget. In FY '72, it had risen to 30.4% — a 22% acceleration in one year. This cost escalation had made the "level funding" concept impractical. Recent DoD messages have predicted a conservative 35% increase in FY '74 navy standard fuel cost. The FY '74 budget is cast in legislative concrete. If the actual costs are 35% greater than the funds budgeted, this will consume an additional $49 million for operations and maintenance in an already tight FY '74 budget.

Fuel Shortage

The other horn of our dilemma is that the necessary fuel simply may not be available at any price. Strict air pollution standards for environmental protection have required mandatory conversion of coal and oil-fired plants to natural gas. But the supply of natural gas has not kept pace with this new requirement in addition to the normally increasing demand. The Federal Power Commission anticipates critical shortages of natural gas for much of the nation as early as FY '74 and has established priority criteria which gives preference to domestic use and commercial users.

Least priority has been assigned to large industrial systems on interruptible service, including defense activities. As a result, such systems could be without gas all throughout the coming winter. These priorities may ultimately affect firm supply contracts as well.

In light of this situation, the DoD has established a moratorium on all conversions from coal to other fuels and has informally recommended caution in the use of natural gas. The secretary of the navy has further directed the establishment of a minimum 30-day fuel storage capability (based on the coldest period of the year) where gas shortages can be expected. A recent survey in response to this direction has identified a navy-wide fuel storage deficiency of over $8 million, with $760,000 of deficiencies critical enough to warrant immediate urgent minor construction support. Obviously, providing this needed capability will cause competition for already inadequate military construction and maintenance and operation funds. The simple fact remains, however, that natural gas constitutes approximately 30% of the fuel used by the naval shore activities; larger users may have no gas and be completely dependent on standby fuels.

Shortage Impact

In an effort to evaluate the impact of the energy shortage, the chief of naval operations has estimated the FY '74 shore establishment fuel oil requirements at over 524 million gallons. This estimate is based on holding consumption to the FY '72 level and will be difficult enough to meet considering the normal historically rising trend. But FY '72 was an unusually mild heating and cooling year for most of the nation and actual energy usage could exceed this estimate by 30% or more, simply by a change in the weather. We must make plans now for the possibility that there may not be enough fuel this winter. The

secretary of the navy has also directed a navy-wide 3,000,-000 barrel (126 million gallons) reduction in fuel oil usage during FY '74. The immediate result is a substantial reduction in steaming days of the fleet and flying hours of the air command. This reduction will have a direct impact on the shore establishments as well as the fleets and the air arm.

Looking Ahead

Anticipating the potential consequences of the energy crisis, the navy has been working to minimize its impact. An *ad hoc* committee, the Energy Resources Group (ERG) in NAVFAC, has been directed to examine the impact of energy shortages on the navy shore establishment and recommend appropriate courses of action to soften this impact. The group is taking a broad overlook at the entire energy situation rather than focusing on current operational problems.

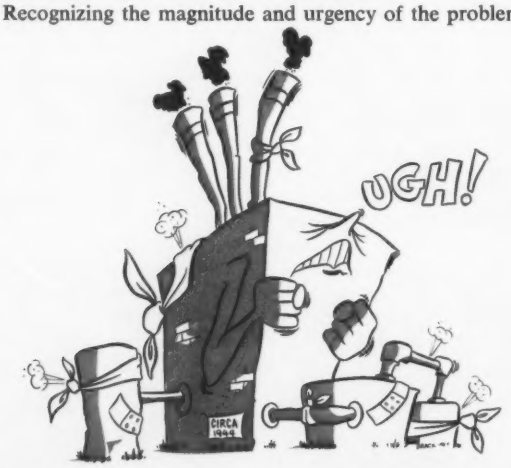
The naval research community is making extensive studies of navy wide energy use, the application of total energy concepts to the navy and the feasibility of new energy sources in meeting the future energy requirements. Executive, DoD and navy policy direction is also being formulated to guide future actions.

Existing Programs

However, these efforts will not have much effect in the winter of 73-74; existing available resources will have to be used to solve the day-to-day problems. Many existing utilities problems have had spin-off effects of conserving utilities energy. The utilities cost analysis report has been specifically designed to help management analyze the utilities systems on a regular basis and indicate areas in need of remedial attention. The utilities improvement program and added emphasis in MILCON Investment Category 17 has resulted in the funding of more of the increased-efficiency-type projects. Without this support these projects historically had very poor visibility in competition with more glamorous direct-line support projects.

The pollution abatement program has also provided increased funding of projects to improve old, inefficient and polluting boilers. The cold iron program does more than permit leave for the sailors manning shipboard utility systems while in port: it reduces the fuel consumption in direct proportion to the ratio of the shore system's efficiency over that of the shipboard system's.

Recognizing the magnitude and urgency of the problem,



Almost 80% of the navy's utilities were installed before the end of World War II.

The navy's utilities are almost on their knees.

NAVFAC is developing, "on-the-run," a coordinated utilities energy conservation program (UECP), a logical re-emphasis and extension of the existing utilities conservation program (UCP). It will make the quickest, most effective use of the limited resources available. Designed primarily to conserve limited utility funds by identifying and eliminating utility wastage, the program has been effective in the past and while it has been de-emphasized due to limited resources, the value of conservation is still ingrained in naval personnel. This can be seen in the fact that their efforts have held the navy's electrical load growth to approximately 3% annually, as compared to the average national growth of 7%.

Energy Conservation

The new utilities energy conservation program will take an initial look at all areas of utilities management, engineering and design as well as the available existing programs. Using this information, it will determine what immediate energy conservation action can be taken, and where future, more in-depth work will be most effective.

In the utilities management area, usage conservation will be greatly re-emphasized. The *Utilities Target, Utilities System Analysis* and *Activities Conservation Techniques* Manuals (MO's 303, 304 and 305) were all rewritten in the spring of 1972. MO 303 provides procedures for estimating efficient utility usage that could be expected from each system element, comparing this estimate with actual usage and identifying specific areas of waste and potential savings. These procedures also provide a method for identifying the magnitude of potential savings and indicate the areas of concentration for high payback on specific utility systems. MO 304 is designed to help utilities systems analysis teams carry out detailed studies of utilities systems in which conservation problems have been identified. The recommendations of these teams help the activities themselves control utility wastage. MO 305 is designed to help the responsible activity's conservation officer in organizing, promoting and maintaining a realistic, effective conservation program at his particular base. It contains specific recommendations of actions he can take to reduce energy wastage.

Milcon Support

In addition to the conservation effort, the existing utilities improvement program and NAVFAC's role as technical

(*Continued on page 30*)

NMCB STATUS REPORT

By LCDR J. D. PENSYL, CEC, USN
Seabee Capabilities Branch Head, NAVFAC
• Alexandria, Va.

Seabees continue their worldwide employment, attempting to satisfy existing and projected requirements which grow increasingly larger.

Several milestones were met at the number one employment site as the Naval Communications Station on the island of Diego Garcia became operational on 20 March 1973, two years after the first Seabees arrived. NMCB-62 completed the airfield pavement before being relieved by NMCB-74 in March, and C-141 aircraft are landing on a regular schedule. Additionally, the augment for Diego Garcia is now provided by the Roosevelt Roads NMCB instead of the battalion deployed to Europe. This change became effective when the NMCB-10 detail relieved the NMCB-133 detail in June 1973.

The main body of NMCB-10, employed at Roosevelt Roads, is putting the finishing touches on the Navy Telecommunications Center. This major project was 95 percent completed by NMCB Four when it was relieved in May by NMCB-10. In addition to Diego Garcia, NMCB-10 has details at Guantanamo Bay, Cuba; Canal Zone; Bermuda; and Argentia,Newfoundland. Work is also scheduled for Grand Turk Island in the Bahamas.

Probably the most dispersed battalion is NMCB-133, whose main body is located at Rota, Spain with details at Soudha Bay, Crete; Sigonella; Nea Makri, Greece; Naples; Todendorf, Germany; and La Maddalena, Sardinia. Their mix of projects is as diverse as their locations and includes installation of no-break generators, well-drilling, and construction of a swimming pool, building additions, bathhouse, sewage disposal system, fuel tanks, gym addition and various other base facilities. NMCB-133 also has a Seabee Team which closed out the Kusaie site in TTPI in June, leaving only four Navy Seabee Teams in the Trust Territory.

In addition to the Seabee Teams in TTPI, details from NMCB-1 are employed at Palau and Yap working on the rehabilitation of airfields. The main body of NMCB-1 is on Guam where the opening of the Camp Covington EM Club in April and CPO Club in May now provide all Seabees on Guam with suitable club facilities. Camp roads are ready for paving and the chapel construction is progressiug well as the Guam Seabee camp nears completion. Other NMCB-1 details at Adak and San Miguel are employed on hobby shop construction.

To round out the deployed battalions, NMCB-3 is serving as the Pacific Fleet Alert Battalion on Okinawa. Work on Okinawa includes construction of a staff NCO Club at McTureous, HML Hangar, ASP Security Fence, Butler Buildings and parking lot. At the Seabee camp, Camp Shields, the new officers' club was opened in late April and progress continued on BOQ-3. The old O-club was demolished to facilitate landscaping around the new club. NMCB-3 also has details in Taiwan working on barracks rehabilitation and construction of duplex cabins; Iwakuni, in Japan working on a marine corps confinement facility, exchange warehouse, and water line; and in the Philippines constructing an aircraft rinse rack and runway support facilities.

Both of the Amphibious Construction Battalions, PHIBCB-1 and PHIBCB-2, kept engaged primarily with fleet exercises and other training operations. Additionally, PHIBCB-1 found time to accomplish earthwork for a canoe lagoon and camping area at Imperial Beach, place and remove concrete obstacles in South Bay for UDT and Seal Training, and complete the first increment of a sheet pile bulkhead project. On the other coast, PHIBCB-2 continued construction on the boat marina at the Little Creek Amphibious Base.

CBMU-302, reduced from its large Vietnam era strength to one officer and 49 enlisted men, and relocated to Subic Bay, Philippines, finally reached its authorized strength this period and attained full operational status. The unit to date has been concentrating on military and technical training, particularly training on the main power plant at Subic Bay.

Several significant changes occurred with respect to the naval construction regiments. In early April, 21 NCR at Davisville consolidated stafffunctions with COMCBLANT to compensate for fleet staff reductions. For the same reasons, 32 NCR on Roosevelt Roads was disestablished on 1 July and in the Pacific area, 30 NCR was assigned a permanent duty station on Guam vice Okinawa effective 1 July and absorbed COMCBPAC DET Guam.

No report on the Seabees would be complete without a rundown on the Construction Battalion Units. Two of the 17 CBUs fell victim to shore establishment realignment actions: CBU 408 at Newport and CBU 409 at Alameda are scheduled to be disestablished in FY-74. The other units continue to find themselves fully occupied with the Self-Help/Habitability Improvement Programs. Projects range from very simple bus shelters to marinas, large hobby shop complexes, and 98-pad mobile home parks, as Self-Helf has ceased to be a concept and has become a way of life in the navy.

A NAVY REPORT

Small Incinerator Technology

By JOHN KLOTE
Mechanical Engineer, Design Div., NAVFAC

• Alexandria, Va.

In the past, incinerators have frequently been cheaply built fire boxes that fouled the air with smoke and odors. Many of these units operated inefficiently, charring wastes on the surface rather than completely incinerating them. These units have given incineration a "bad name." Many people have said that incinerators should be abandoned altogether in favor of well-managed landfills. However, efficient non-polluting incinerators are now available and landfill costs are increasing.

Incineration technology and air-pollution control technology are presently making vast advances. Theoretical concepts and conventional practices from other fields are regularly being applied to incineration with a good degree of success. The design division of NAVFAC is constantly evaluating new advances to determine the most economical method of solid waste disposal. In spite of the "bad name" incinerators have, there are some capable of reducing waste to sterile ash without causing air or water pollution. At some locations these units are the most economical methods of solid waste disposal.

For incinerating capacities up to 4000 lb/hr, NAVFAC recommends two incinerator types. One is the controlled-air incinerator and the other is an incinerator of conventional design (retort or in-line) with a venturi flue gas scrubber.

Controlled-Air Burning

Controlled-air incinerators with waste destruction capacities of 50 to 2,000 lb/hr are currently being produced by a large number of manufacturers. Generally, these units are constructed of a steel outer shell with a castable refractory inner lining (see Figure 1). Waste is charged into the ignition chamber where it burns with air which is controlled to below theoretical air. The air pollution control device is an afterburner in which particulate matter and volatile gases are burned. The volatile gases reduce the fuel requirement of the afterburner. Afterburner temperatures must be maintained in order to incinerate particulate matter and destroy odors. These temperatures vary with the waste and the individual incinerator design, but normally are in the range of 1400-1800°F.

After a controlled-air incinerator has been continually loaded and fired for approximately six hours, a thick bed of charred waste has formed in the ignition chamber. At this point, the day's loading has ended and the burners are turned off, while the underfire air fan is left operating. After an all night burn-out, the material in the ignition chamber has been almost completely reduced to white ash.

Industry rates the capacity of controlled air incinerators in a manner different from the conventional method for other incinerators. Retort, in-line and municipal incinerators are all rated on the material incinerated per period of time (lb/hr or tons/day). Controlled air incinerators are rated in terms of the material loaded rather than material incinerated. Thus a 2000 lb/hr rated controlled-air unit can be loaded at 2000 lb/hr for approximately six hours and thus can destroy 12,000 pounds of waste per day. Rating these incinerators on a daily basis would be more realistic. A 2000 lb/hr in-line incinerator operated on one shift a day would destroy the same amount of waste. However, the in-line incinerators are capable of two or even three shifts a day, whereas controlled-air units can only operate one shift per day as explained above.

Emission Level Testing

Several manufacturers have had their controlled-air incinerators tested by the Environmental Protection Agency (EPA). Units which had tested emissions lower than 0.2 grains per standard cubic foot corrected to 12% CO_2 (gr/SCF corrected) have been certified by EPA. EPA will supply the names of these units upon request. In the near future EPA will publish a compilation of these tests, along with the emissions corrected to 12% CO_2. This information may be useful for locations where local standards are more stringent than 0.2 gr/SCF corrected.

The emission levels depend upon the quantity of underfire air, the temperatures of the ignition chamber and the

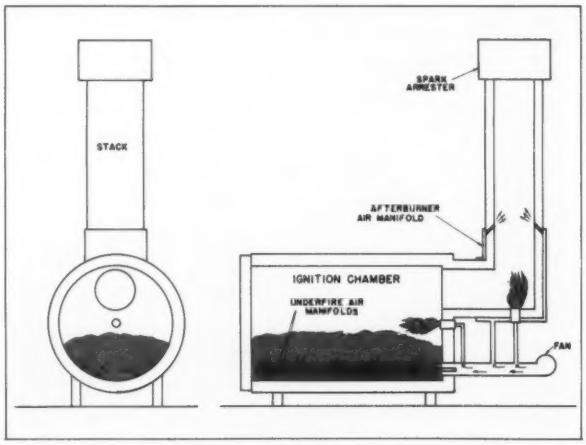


Figure 1 — Typical controlled-air incinerator

afterburner, the manner in which wastes are loaded, and the material being incinerated. This is the reason that results from different tests on the same incinerators are generally very different. Incinerators which have demonstrated very low emissions on a test have done so with very careful operating procedures. It is unlikely that, during normal day-to-day operations, controlled-air incinerators can maintain emission levels below 0.05 gr/SCF corrected. At locations with more stringent regulations, conventional in-line or retort incinerators with flue gas scrubbers are recommended.

Conventional incinerators are constructed of a fire brick inner wall and either insulating block and steel outer shell or an air space and a common brick outer wall.

Scrubber Trade-Offs

Scrubbers used for general refuse incinerators have been subject to severe corrosion by the high acid (pH 2) scrubber water. Mild steel has a useful life of only a few months in this service while stainless steel lasts a year or two. Clearly these materials are unacceptable. Fiberglass reinforced plastic (FRP) and plastic lined steel (PLS) are sufficiently corrosion resistant. However, they have temperature limitations in the range of 200-250°F., so combustion products must be cooled by air mixing, heat exchangers, or evaporative cooling. Mixing with ambient air doubles the volume of gases to be cooled and thus doubles the scrubber operation cost. Heat exchangers are even more expensive. Evaporative cooling towers are less expensive than the other two methods.

Another problem with scrubbers is high water consumption. This can be reduced by water recirculation; however, several scrubber designs are prone to nozzle plugging from recirculated water. When built of FRP or PLS, centrifugal scrubbers, orifice scrubbers, spray towers, flooded bed scrubbers and scrubbers with self-induced sprays all require evaporative cooling towers. These scrubbers are no more efficient for air cleaning than the afterburner. Because scrubber-equipped incinerators are several times more costly to purchase and to operate, they are not recommended over controlled-air incinerators with afterburners.

Venturi Scrubbers

Venturi scrubbers are capable of the highest collection efficiencies and they are recommended for locations where the local regulations are more stringent than 0.05 gr/SCF corrected. Combustion products at 1300-1500°F. enter the venturi throat, (see drawing), where velocities reach 200-600 ft/sec and the gases are turbulently mixed with water. This highly turbulent action has two effects: (1) almost all particulate matter is entrapped by the water and (2) the combustion products are evaporatively cooled to saturation temperature (165-175°F),which allows the use of plastics down stream of the venturi.

The gases leaving the venturi throat at high velocities contain a large number of suspended moisture droplets containing entrapped particles, which are passed as a spray into a moisture separator sized for an average gas velocity of 6-8 ft/sec. Moisture separators with baffles are capable of the high performance necessary and these separators are, therefore, recommended over cyclonic separators, which do not remove enough of the particulate-bearing moisture droplets to achieve the required emission levels.

The collection efficiency of venturi scrubbers depends upon the pressure drop across the venturi, the rate water is injected into the venturi throat, the venturi geometry and the type of particles being collected.The water injection rate is in the range of 5 to 10 gal per actual 1000 CFM of flue gas in the venturi throat.

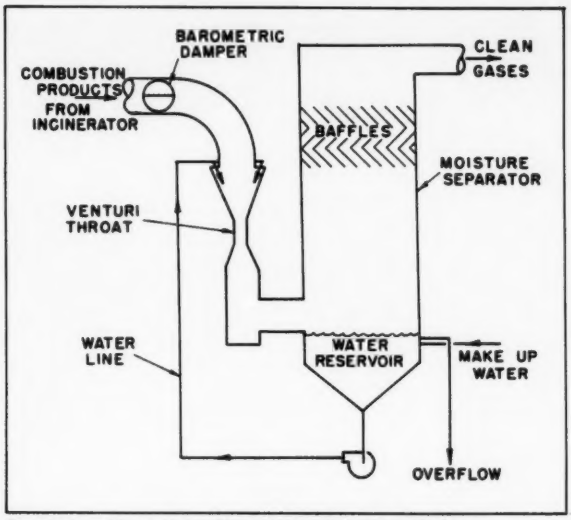


Figure 2 — Venturi scrubber and moisture separator

For a particular scrubber, if the rate of water injected and the type of particles collected are unchanging, then the collection efficiency depends only upon a constant pressure drop across the venturi. This is essential with incinerators, to achieve a uniform collection efficiency. This constant pressure drop can be achieved by using a constant CFM induced-draft fan and a barometric damper up stream of the venturi. The constant gas flow thus results in a constant pressure drop and constant collection efficiency.

An alternative method is a venturi with a variable throat area. These variable throat area scrubbers can maintain constant collection efficiency and conserve fan power; however, they have high initial costs.

Some venturi scrubbers have water nozzles in the venturi throat and other designs have no nozzles. Venturi scrubbers without nozzles are recommended because the scrubber water can be recirculated without nozzle plugging problems.

Scrubber water overflow should be discharged to the sewage system only after the effluent pH has been raised to near neutral (5-6). A survey should be made to determine if the sewage treatment facilities can handle the added load.

Future technology advances will probably produce more economical methods of solid waste disposal. Heat recovery and electrostatic precipitators may be applied to incinerators of the 2000-4000 lb/hr capacity. Presently, both these advances are being incorporated in many municipal incinerators (100 ton/day and larger). If the energy crisis is any portent of things to come, energy costs could double in ten years. Heat recovery would clearly be advantageous and electrostatic precipitators consume only small amounts of power. Of course, such equipment must have life cycle cost advantages over alternative methods of waste disposal.

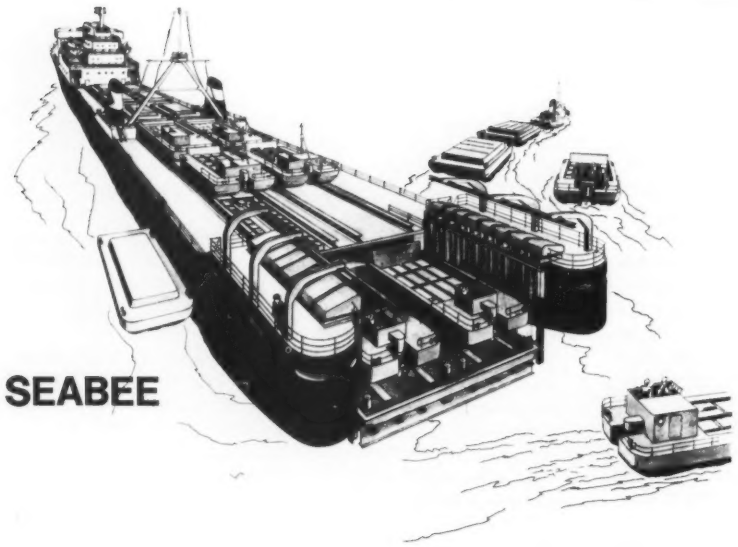
For the present, however, NAVFAC recommends controlled-air incinerators for navy facilities at locations where standards are 0.05 gr/SCF corrected or greater. At locations where restrictions are more stringent, in-line or retort incinerators with venturi scrubbers are recommended. Alternative waste disposal methods, such as landfill and recycling, must always be examined to determine the most economical method of solid waste disposal.

Bargeships in Amphibious Logistics

By MILTON E. ESSOGLOU
and J. T. RUHRER
Plans & Programs Div., NAVFAC
• Alexandria, Va.

The availability of LASH and SEABEE ships (24 LASH and 4 SEABEE), with their unprecedented outside and heavy lift capabilities, allows for the transport and landing of large components for the rapid development of unprepared beaches into facilities equivalent to ports.

Large general purpose amphibious advance base components like NL or AMMI pontoons now can be transported only in LSD well-decks or side-carried on LSTs. Both of these ships have assault-critical missions and are limited in numbers. Large components, like the army's DeLong Barge Piers (BPLs) which are up to 300 feet long, can only be towed at five knots. Furthermore, the discharge of containers from LCUs or non-beaching lighters requires cranes no less than 100-ton capacity. The transport and rapid erection of large platforms and cranes, so that they are available in the objective area when the containerships and bargeships arrive, is not now possible. Yet, this capability is absolutely critical to *any* port-like function, especially involving containers and barges.



LASH

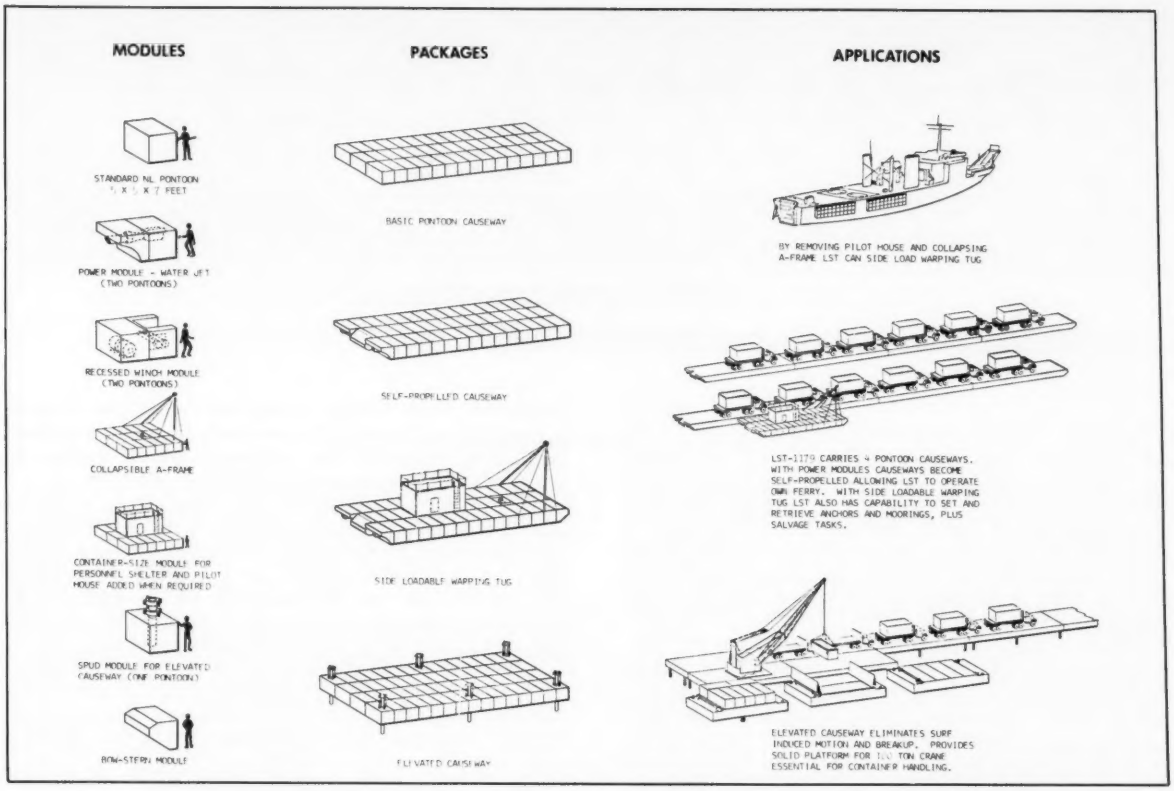
The most efficient way to transfer cargo (specifically containers) is the conventional pier and causeway and off course cranes, as appropriate. When conditions preclude this, lighterage is used. Fast over-the-beach lighterage like heavy lift helicopters (HLHs) and air-cushioned vehicles (ACVs) are *best* but they cost too much to build, operate and maintain in terms of components, fuels and, most of all, highly skilled manpower.

Consider the relative technologies of a 50-knot, 75-ton ACV versus a 9-knot, 180-ton LCU versus a 2-knot, 100-ton NL pontoon, etc.

Ship-to-shore gradients are such that the use of causeways is required, as history has amply demonstrated. Floating causeways are susceptible to surf and storms, whereas elevated causeways would not be. The 20-knot bargeship opens the gateway to the abundant use of elevated causeways to connect the crane platforms to shore and provide for wharfs.

Components for the amphibious logistic system — other than assault wave or long-standoff or vertical envelopment tasks — are proposed to be simple and cheap and centered about the pontoon causeway module. This module satisfies most requirements for performance and logistics simplicity. Figure 3 shows how it satisfies causeway, lighterage and tug requirements, maintaining compatibility with LSTs and most importantly, being transportable by LASH and SEABEE.

Only the pontoon and its end connections are now in the system. Components to be developed are: (a) jack-


MODULES
PACKAGES
APPLICATIONS
STANDARD NL PONTOON
POWER MODULE - WATER JET (TWO PONTOONS)
RECESSED WINCH MODULE (TWO PONTOONS)
COLLAPSIBLE A-FRAME
CONTAINER-SIZE MODULE FOR PERSONNEL SHELTER AND PILOT HOUSE ADDED WHEN REQUIRED
SPUD MODULE FOR ELEVATED CAUSEWAY (ONE PONTOON)
BOW-STERN MODULE
BASIC PONTOON CAUSEWAY
SELF-PROPELLED CAUSEWAY
SIDE LOADABLE WARPING TUG
ELEVATED CAUSEWAY
BY REMOVING PILOT HOUSE AND COLLAPSING A-FRAME LST CAN SIDE LOAD WARPING TUG
LST-1179 CARRIES 4 PONTOON CAUSEWAYS. WITH POWER MODULES CAUSEWAYS BECOME SELF-PROPELLED ALLOWING LST TO OPERATE OWN FERRY. WITH SIDE LOADABLE WARPING TUG LST ALSO HAS CAPABILITY TO SET AND RETRIEVE ANCHORS AND MOORINGS, PLUS SALVAGE TASKS.
ELEVATED CAUSEWAY ELIMINATES SURF INDUCED MOTION AND BREAKUP. PROVIDES SOLID PLATFORM FOR 100 TON CRANE ESSENTIAL FOR CONTAINER HANDLING.

AMPHIBIOUS PONTOON MODULE SYSTEM

up modules, (b) waterjet propulsion, (c) fold-down/recessed winches, A-frames, etc., for sidecarry on LST or stacking on LASH, (d) lift/launch components and techniques for LASH, (e) crane platforms transportable in LASH, (f) causeway-integral turntables for truck turnaround, (g) lift-on/lift-off causeway ferry techniques and components, (h) minor simplifications and improvements, and (i) system integration.

Essentially, these are one-of-a-kind needs to be developed for experimentation and perfection prior to preparing procurement specifications. There is no high-risk technology other than structural, hydraulic, and marine engineering. All risk arises from requirements for reliability, simplicity, cheapness and management acceptance in a high technology-prone environment.

The technological gaps are:

a. Compact-pontoon modular-waterjet propulsion; rugged for LST sidecarry and LASH barge tug functions.

b. Pontoon jacks that work simply and reliably in the sand/surf/low skill amphibious environment — for causeways or crane platforms.

c. Lifting of 22'x90' and 60'x90' platforms by means of the now 30'x60' limited LASH gantry.

d. Holding platforms for elevating in an 8' surf or 6' wave environment.

The approach allows for: (a) utmost exploitation of existing navy causeway assets and procedures, (b) eliminating demands for LSD well-deck space, (c) utilization of LASH or SEABEE as an amphibious augmentation ship with as much capability as an LSD, (d) reducing or eliminating dependence on a 5-knot towable DeLong platform for discharge of LASH or SEABEE non-beaching barges in 9' of water, (e) transport of the LST sidecarried 22'x90' navy causeway modules in LASH and SEABEES, (f) the lift-on, lift-off lightering of cargo (containers, break-bulk, outsized or whatever) to the beach; or allowing for causeway ferry drive-on, drive-off cargo flow or the discharge of 9' draft LASH, SEABEE barges (or any barge), (g) tugs common to both amphibious operations and the LASH/SEABEE barges, (h) transport of cranes, crane platforms, and all essential components for through-putting cargo, (i) the combination of this simple and rugged system with assault-driven ACV's and HLH's for total flexibility, (j) minimization of total navy (DOD) life-cycle costs, allowing more dollars and sailor skills for ACV's and HLH's without compromising effectiveness, (k) operational commanders to utilize any ship-to-shore mode they consider most appropriate, and (l) optimum utilization of LASH or SEABEE ships and barges as available.

Very simply, the present capabilities for over-the-beach discharge of commercial ships and the development of advance bases is now unnecessarily constrained (or even non-existent) by concepts and techniques developed during the breakbulk Liberty ship era. The possibilities available with the bargeship are enormous and outweigh the problems of rapid erection of cargo discharge facilities. All waterfront port, POL and craft repair facilities can be pre-assembled in and returned to the U. S. as necessary, radically reducing construction time and assets.

A Profile of NAVFAC's Engineers and Scientists

By P. CROWLEY
Personnel Services Office

• Alexandria, Va.

In March 1972 the command issued the Facilities Engineering Career Plan (NAVFACINST 12950.1) to implement the objectives established by the navy-wide Civilian Engineer and Scientist (E&S) Career Program. The command plan places special emphasis on development of personnel through "individual career development plans" which involve training and rotational assignments in such areas as facilities planning, design, construction and maintenance.

Career program administrators periodically survey functional segments of the navy work force. Survey results provide direction in preparing objectives to improve personnel quality and performance in areas of greatest need, including those considered most critical for mission accomplishment. Using a questionnaire developed by the Career Management Center, a survey was completed in 1972 that established a profile base on the navy E&S group. Follow-up surveys will be conducted to determine long-term trends and to perform progress evaluations regarding skills requirements, trainee intake, training, mobility, etc. In this article, the NAVFAC E&S group is analyzed along these lines from responses to the questionnaires. More than 80% of the command E&S group, represented by all its activities, participated in the survey.

A fundamental characteristic of this professional group is education level obtained.

EDUCATION

DEGREE	NAVFACENGCOM (%)	NAVY
PHD	1	6
Master's	13	19
Bachelor's	81	72
Less than Bachelor's	5	3

This shows that the NAVFAC E&S group compares favorably with the navy-wide group with 95% of the command group having a bachelor's or higher degree versus 97% navy-wide. The navy-wide group has a higher percent of personnel with advanced degrees because it contains a larger proportion of RDT&E personnel.

The command grade groups (see Figure 1) at the senior and middle levels compare favorably with the navy-wide grade structure. At the entry or trainee level the command does not show the same input as the others. Considering the high attrition rate the command will be experiencing during the next several years, this statistic shows a need for critical analysis of our college-caliber recruiting needs.

Manpower planning involves monitoring the distribution of full-time personnel by occupational area within and between headquarters and field. A surprising finding is the consistent distribution of personnel along these lines as seen here.

FULL-TIME PERSONNEL BY MAJOR OCCUPATIONAL AREAS

AREA	HQTRS	FIELD	TOTAL
Civil (33%)	89 (23%)	290 (77%)	379
General (28%)	90 (28%)	230 (72%)	320
Mechanical (12%)	30 (22%)	107 (78%)	137
Mech./Electrical (12%)	27 (20%)	109 (80%)	136
Architecture (11%)	26 (22%)	92 (78%)	118
Industrial (4%)	10 (20%)	40 (80%)	50
(100%)	**272 (24%)**	**868 (76%)**	**1140**

General and civil engineers in both headquarters and field are the two largest occupational areas: combined they constitute 61% of the total work force surveyed. Overall, field personnel comprise 76% of the total number of full-time personnel.

Closely related to the above is the percent of personnel employed by functional area either in a full or part-time basis, as shown in Figure 2. Since the survey question allowed personnel to indicate more than one function in

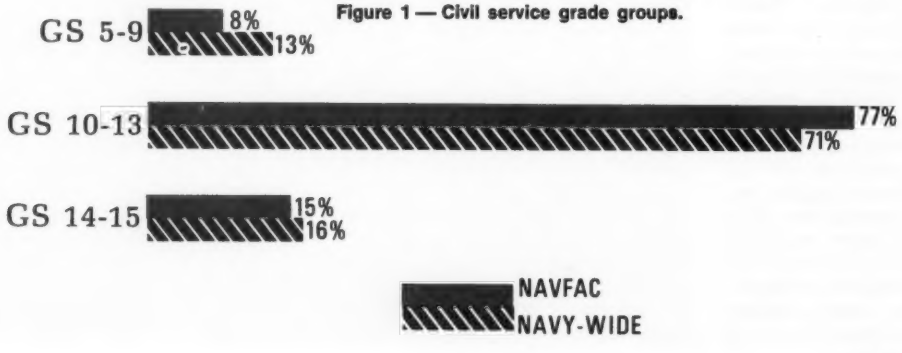


Figure 1 — Civil service grade groups.

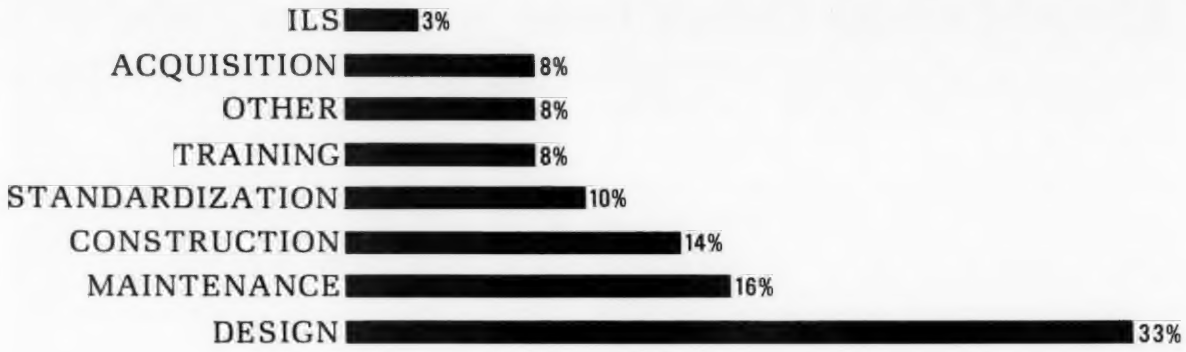


Figure 2 — Personnel distribution by function (full or part-time).

which they were working, these figures do not represent a distribution by man-years. The "other" category includes mostly personnel in facilities planning, MILCON programming, civilian defense, readiness planning and RDT&E. Further refinement of this area is needed in a future survey.

Probably the single most critical characteristic of work group when viewing the need for organizational continuity is its age distribution by grade groups.

AGE DISTRIBUTION

GRADE GROUP	35 & Under	35-44	45-54	55 & Over
GS-5/9 — 106 (8%)	92%	4%	3%	1%
GS-10/13 — 995 (77%)	24%	24%	31%	21%
GS-14/15 — 193 (15%)	3%	24%	43%	30%
Total — 1294 (100%)	**26%**	**23%**	**30%**	**21%**

Attrition, of course, varies according to the retirement laws in effect as well as the comparative attractiveness and availability of positions in other government agencies and private industry. Thirty percent of the GS-14/15 senior managers were 55 years of age or over, as shown above. Forty-eight percent of the GS-10/13s were 44 years of age or under and were available at a ratio of 5-1 for selection to those GS-14/15 positions whose incumbents were approaching retirement. Since only 8% were at the GS-5/9 level the inference is that the Command should be hiring proportionately more GS-5/7s to assure having adequate numbers of well-trained journeymen during the late 1970s and 1980s.

The data shown in the mobility table below seem to indicate our people on a command wide basis have been rather mobile.

MOBILITY

	Field to Field (Total)	Field to Hq (Hq only)	Hq to Field (Total)	Moved in last 5 years (Total)
Major Commands	19%	23%	3%	13%
NAVFACENGCOM	38%	34%	8%	29%
Construction	46%	40%	9%	36%
Design	35%	28%	6%	26%
Maintenance	40%	34%	9%	29%

Of course, a primary reason for such mobility in the last five years, aside from the nature of our mission, is that 13 EFDs were consolidated into six in 1970. The daily evidence, however, shows that mobility opportunities, especially at overseas locations, are not filled often enough by people from the NAVFAC staff.

Mobility that is planned in accordance with "individual career plans" is the keystone to this program because it enhances individual growth and opportunity and strengthens the organization by assuring the presence of trained, capable people in key positions. Planned mobility at the mid-level, for example, can develop high-potential professionals into well-rounded managers via developmental assignments in specified career patterns in such areas as planning, design, program management and coordination of engineering projects. As these professionals advance to key positions, they will more likely be mobile and provide a resource of personnel available for positions over a wide geographic and functional range.

An organization that trains its people not only evidences a climate of concern for its people and enhances individual motivation but contributes to building a more efficient work force. An obstacle to meeting training needs is the continuing plea that people cannot be spared from their offices to attend courses, or that funds are not available for training. As in other endeavors, planning on a long-range basis, especially when funds are made available through inclusion in operating plans, can do much to convert training plans into realities.

The command record in training its people parallels that of the other commands.

PERSONNEL RECEIVING TRAINING (w/in last 5 years)[1]

	Technical (%)			Mgt/Admin (%)		
	Hq	Field	Total	Hq	Field	Total
All Commands	54	59	58	38	28	30
NAVFACENGCOM	49	43	44	42	31	33
Construction	38	44	43	29	39	37
Design	61	41	45	35	23	25

[1]At least one course of 40 hours duration or 2 semester credits of equivalent.

The figures show, however, that technical training of field personnel lags 16% behind the other commands. An emphasis on training guidance provided in the Facilities Engineering Career Plan, specifically the preparation of "individual career development plans" on a fiscal year basis, should reduce this deficiency.

In summary, the profile shows a need for review of the command requirements for greater trainee input and an emphasis on technical training of field personnel when the total navy experience is used as a guide. NAVFAC's distribution of people by grade level structure is comparable to the other commands; it is in good shape regarding level of education attained by these professionals; and it shows a pattern of mobility surpassing the navy-wide experience.

Oil Spill Recovery Systems Tested in San Diego Harbor . . .

• Port Hueneme, Calif.

All but one quart of 75 gallons of oil deliberately spilled in a navy harbor were cleaned up by an experimental removal and recovery system tested under a continuing research and development program conducted by the Naval Civil Engineering Laboratory (NCEL), Port Hueneme. The system included the most promising commercial containment, recovery, storage and transfer, and oil-water separation equipment evaluated by NCEL during a series of extensive tests during the past year.

The operation, performed by the Long Beach Research Facility of Battelle Memorial Institute under contract to NCEL, was considered a complete success.

After conducting numerous tests of equipment in pools, rivers, wave basins and on land, NCEL selected the best performing subsystems and components, which were then assembled into complete confined and open area clean-up systems for harbor spills. But before the laboratory could accept those systems as points of departure for further development and, could, in the interim, provide the navy with guidance for urgent procurements of clean-up equipment, the total systems had to be tested under known conditions in a harbor environment using an actual oil spill to provide the precise engineering data necessary for rational decisions.

With the approval of the Environmental Protection Agency, 75 gallons of navy distillate fuel oil were spilled in an open area of the Long Beach Naval Shipyard. Using NCEL's selected equipment for an open area system, Batelle recovered the oil. The equipment included oil skimmers, booms, a towable "pillow" tank, oil/water separators, and a surface-tension modifier to herd the oil. A commercial oil recovery contractor was on site with safety backup equipment. But it wasn't needed. The test

NCEL's futuristic system for recovery and removal of oil spills.

was conducted with the cooperation of the shipyard and the Long Beach Naval Station.

The primary device used in the operation was a skimmer with two lengths of oil-containment boom attached to aid in guiding oil into it. A secondary boom was deployed downwind of the skimmer as a precaution. A smaller skimmer stood by to recover any oil that escaped the larger recovery device.

The oil was spilled from an LCM-8 into the test area between the containment booms attached to the primary skimmer. After the oil was discharged, the boat moved behind the secondary boom downwind from the primary oil recovery unit.

During the recovery tests, Battelle engineers and technicians collected oil and water samples, measured the oil collection rate, took water temperatures and compiled current data for later analysis.

The Long Beach harbor test marked the successful completion of phase one of NCEL's four-year program. The first phase resulted in the development of the better system using existing off-the-shelf hardware. The laboratory has now entered phase two: development of improved systems based on new concepts and technologies.

. . . and in Boston Harbor

• Alexandria, Va.

By PAUL F. NADEAU

Environmental Protection Coordination Office, NAVFAC

The first phase of a field test program to investigate the optimum use of oil spill cleanup equipment was recently completed for the navy at the Boston Naval Shipyard. The primary objective was to assess oil spill cleanup systems, and determine how to make best use of available equipment for cleaning up oil spills at pier side and in open waters.

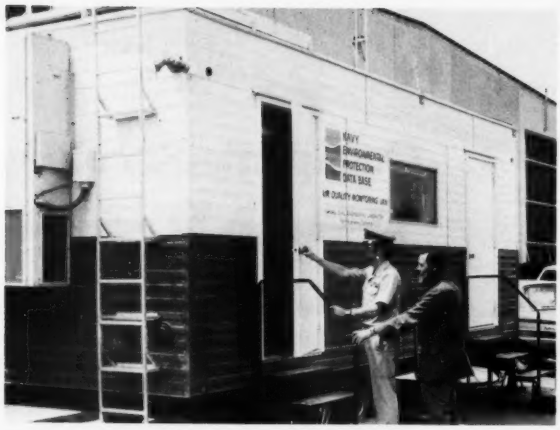
Over 75 tests were conducted, using dynamic inclined plane (DIP) skimmers in combination with oil containment boom, piston film (a chemical used to confine, condense, and control spilled oil), and sorbents (material capable of adsorbing oil from the water surface) to clean up various types of spilled oil. Wind, natural water currents, and induced water currents were also used when possible to facilitate the cleanup effort.

In each test case the total time required to recover the spilled oil and the condition of the water surface after cleanup were recorded. This provided the necessary data for evaluating the effectiveness of each oil cleanup scheme, and eventual selection of the optimum cleanup scheme for each spill situation.

Test results confirmed that equipment does exist which can be combined into effective operational systems. In most instances, the oil recovery rates and the percentages of spilled oil recovered from the water surface were enhanced by the proper use of auxiliary components in combination with the DIP skimmers. As an example, in one series of tests, the oil recovery time was cut from 60 minutes to 10 minutes by the addition of piston film to the test situation. This time saving can be very important when working on a large spill with only a limited amount of equipment and manpower available.

The data generated from this program will provide the foundation for a navy operators manual to assist navy personnel in implementing oil spill cleanup techniques now available. The data will also help in preparing oil spill contingency plans for each navy installation which will insure a rapid and effective response to all oil spill situations.

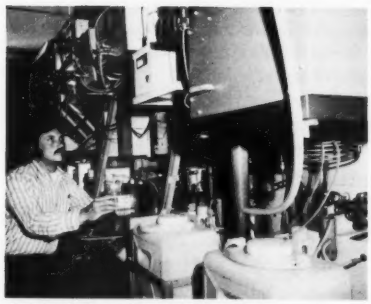
To assist the field activities prior to completion of the operators manual, a Phase I report, which discusses the various cleanup schemes in more detail, has been distributed as an enclosure to NAVFACNOTE 6240, dated 27 April 1973. Also, a NAVFAC film demonstrating the techniques developed during the program will be distributed to the field activities in the latter part of 1973.



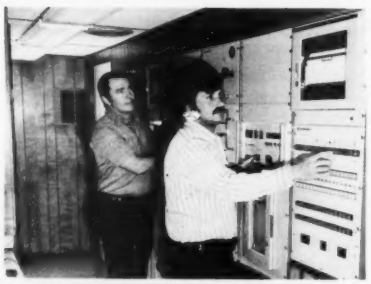
Lt. A. L. Wynn, director of the data collection division of NEPDB (left) and J. S. Williams, environmental protection systems division, enter air quality monitoring van, the air-conditioned, computer-equipped mobile laboratory designed to produce on-the-spot air collection and analyses.

Charles Yee, NCEL project engineer, Harold Riley, leader of the lab's source emission testing team, and Marty Martinez, of the Naval Air Rework Facility, San Diego, (left to right) check out air intake device on roof which draws air samples into the van for testing.

Air Monitoring Van Deployed in Environmental War



Art Schafer, field engineer for van's manufacturer, checks nitrogen oxide detector. White nylon water reservoirs in foreground generate hydrogen gas. The large square device above is a gas chromatograph.



John Collins (left) NCEL engineer and operations manager, joins Schafer in check out procedures on control and status panel.

• Port Hueneme, Calif.

A mobile, self-sustaining trailer, loaded with 24 pieces of sophisticated instrumentation, has joined the navy's fight against pollution. The unit was manufactured for the Naval Civil Engineering Laboratory (NCEL), the Navy's Environmental Protection Data Base program manager.

This $132,000 air quality monitoring van, complete with air conditionin, is designed to operate continuously (365 days a year) at a constant 70 degrees temperature. Its functions are twofold: to analyze ambient air for possible pollutants, and to take meteorological measurements.

The only van of its kind on the west coast, the monitoring unit has its own computer aboard. The data acquisition system takes in all instrument readings and averages them for various intervals, ranging from two seconds to one hour. The average intervals are then transferred onto magnetic tape for further use and reference.

The computer reveals the current status of each instrument, indicating if it is on or off, any power failure, or internal malfunction.

The computer also acts as an electronic sentinel, automatically recalibrating the entire system every 24 hours. All instrumentation is checked with calibrated gases, and electronically, to assure reliable data.

The monitoring equipment will detect sulphur dioxide, ozone, oxides of nitrogen, carbon monoxides, total hydrocarbons, methane, and total particulates. Its meteorological measurements include wind speed, wind direction, temperatures and relative humidity.

The unit's first assignment was in San Diego where it took ambient air measurements for the environmental protection data base program. In mid-June, it was towed to Keyport, Wash. where it is collecting ambient air quality data to be used in an environmental impact statement related to planned construction of a Trident submarine-missile complex.

Vietnamese naval officers undergoing environmental training are briefed by Schafer as their escort, LCdr. David Kuntz, USN, and Lt. Wynn look on.

NAVYWIDE HOUSING SURVEY BY NAVFAC

Occupants Recommend C
Navy Houses In

• Alexandria, Va.

The Naval Facilities Engineering Command has always encouraged occupant opinion to guide improvement of navy family housing. However, until recently, no organized method for collecting this data from a large, representative occupant group has been used. Information has usually been fragmented and inconclusive. The need for a more scientific approach to obtain occupant opinion for establishing design criteria was apparent.

In 1970 navy wives were invited to comment on new house designs. This innovation developed further interest in obtaining views and suggestions. Subsequently, the Assistant Secretary of the Navy for Installations and Logistics directed NAVFAC to conduct a comprehensive survey to obtain the views of navy resident members and their wives on what should be done to improve the livability and appeal of navy family housing. At this point the Assistant Secretary of Defense (Installations and Logistics) became interested in the same objective; subsequently the navy survey program was adopted for use for all services.

NAVFAC developed 52 questions for a minimal evaluation. The Naval Personnel Research and Development Laboratory (NPRDL) assisted to adapt the questions for processing replies by computer, to provide credible sampling procedures for processing the returns, and to help analyze the results. Many of the original 52 questions had to be broken down into several less complex questions for processing by computer, resulting in 126 questions on the final questionnaire.

The questionnaire was divided into two parts. Part I had 19 questions involving technical details about the particular dwelling unit which were filled in by the local housing official who then sent along the complete survey form to the occupant.

The remaining 107 questions were answered by the occupants themselves. The first 104 multiple-choice questions requested information on the occupant's bulky possessions; their preferences and priorities on many housing items; and their opinions on their dwelling unit, the neighborhood and the services provided.

The last three write-in questions solicited the occupants' own ideas on how to improve navy family housing.

9,000 Responses

It was determined that to receive a reliable and representative return, questionnaires must be sent to 16,000 occupants at 15 locations. This was done and the return was gratifying. Over 9,000 navy families responded. Good geographical distribution was achieved and the various types of construction programs under which the housing was built (Wherry, Capehart, and Military Construction Housing) were represented. Eighty percent of the responses were from enlisted personnel and 20 percent from officers. The opinions of wives were reflected in 87 percent of the responses. The data received are considered scientifically reliable and representative of the navy's total inventory of the types of housing surveyed.

The survey material has been put on a magnetic tape and two machine runs have been made. The first categorizes the answers by DoD family housing designation: enlisted men; company grade officers (warrant officers, ensigns, and lieutenants, junior and senior grade); field grade officers (lieutenant commander and commander); senior officers (captain); and general/flag officer. The answers were placed into categories according to the construction program under which each quarters was built for each of the 15 locations, plus a total composite grouping.

The second run grouped and cross-referenced answers. Many checks and balances had been designed into the questionnaire. At the present time, both NAVFAC and NPRDL are analyzing the results. The following preliminary observations may be of interest to the reader.

Our desire to learn our occupants' priorities and preferences on different housing items was indicated by the number of times throughout the questionnaire on which the occupants were asked to make choices. A project designer or a NAVFAC design review board can always get plenty of suggestions on what to add to a project. However, good suggestions are scarce when it is necessary to choose which items to eliminate in order to stay within statutory cost limits. The fact that thousands of our people are affected by such decisions whenever they change duty stations makes it imperative that we consider what they would prefer if they had a voice in making the trade-offs dictated by cost limitations.

Replies to the opinion-type questions show that approximately 75% of the questions evoked majority opinions. For example, the preference was almost four to one for "larger bedrooms upstairs but only one full bath" as opposed to "more than one full bath upstairs but smaller bedrooms." In response to a question on what was considered most important of fourteen features listed, 69 percent selected central air conditioning, own fenced yard, half-bath on first floor, more soundproofing between units, more kitchen counter work space and larger dining space, in that order of importance. The remaining 31 percent selected other features in the following order: patios with private fencing, more interior bulk storage, more exterior bulk storage, carports, secondary eating space, more study space for children and more space for entertaining.

One question showed two floor plans, carefully drawn to show that the total area for either choice was the same. The question sought preferences between two design concepts at the front entrance. One plan was more open, making the living room appear larger; the other provided a wall to give a screened entry and more privacy in the living room. The overall responses were split down the middle. Further study, however, indicated greater preference by enlisted men for the open plan while officers most often preferred the private entry.

By FLOYD BRADD, JR.
Mobile Homes & Criteria, NAVFAC

hanges That May Make
to Navy Homes

Over the years we have been required to gradually increase the number of housing units per acre. This has been done by utilizing townhouse and apartment-type construction. One advantage of townhouse and apartment construction was the reduction of cost by shortening streets and utility runs. However, in putting people closer together, their privacy was affected. The survey results point out this oversight. Among the items chosen by participants as most important to them, four were related to privacy: "air conditioning" (insulate families against outside noise, as well as providing comfort); "own fenced-in yard"; "more soundproofing between family units"; and "patio with privacy fencing." All four rated high, with "air conditioning" and "fenced-in yard" placing first and second overall.

Family Privacy Paramount

Further, in discussing their problems in write-in answers, the lack of fencing and insufficient control over the behavior of other families' children and pets were of great concern. Frequently, devices proposed by architects to improve privacy have had to be deleted to keep a project within the statutory construction cost limits. Such items as fences, patio screens, and landscape planting for screening can easily be cut from a project without reducing the siez or construction quality of the individual housing units. We cluster families closer together to cut project costs, and then we reduce their privacy to further economize. A primary fact that the survey tells us is that family privacy has been treated too lightly.

Several questions related to the placement of different first floor rooms and the garage or carport. Most respondents supported the present DoD Military Family Housing Design Folio layouts with one exception, i.e., the majority preferred that the living room be situated on the street side of the house, which is not now an option in the design folio. The response to these opinion-type questions requiring subjective answers will provide guidance for design decision-making in the future.

A considerable portion of the survey was devoted to questions requiring objective-type answers. The occupants were asked about family size and composition according to age and sex, different appliances they owned, quantity and kind of bulky items, frequency of entertaining guests and the number of people usually entertained. A good example of how this type of information can be used is in regard to parking. Ninety-nine percent of the participants own automobiles, with over thirty-nine percent owning two or more. When the total number of automobiles is added to the number of boats hauled by trailers and recreational vehicles, we have good reason to look more closely at our family housing parking requirements.

Of the families surveyed, only 31% owned dishwashers; however, from the rank of lieutenant commander and above, approximately 75% own dishwashers. This is a clear indication that extra kitchen space should be considered for this appliance for these ranks. The lower ranks, through lieutenant senior grade, had by far the greatest need for storing bicycles and other children's riding toys. The navy showed it was no exception when it comes to America's love for outdoor cooking. Eighty-six percent of the respondents own portable cook-out grills. This percentage remained reasonably constant for the different occupant ranks and ratings.

Entertaining guests is an important family function with definite space requirements. Less than 16% of the respondents entertain more than once a week. The majority entertain from once a week to once a month. Approximately 62% entertain between six to nine guests at sit-down meals. For buffet style meals, the majority have between eight and thirteen guests. The charts show the average number of guests entertained at sit-down and buffet style meals by different rank categories.

It is hoped that these and similar *people-oriented* statistics will assist us in obtaining the necessary authority and funds to improve our criteria. The charts show a need for reviewing dining area design. The most recent family housing design manual does not speak to people-oriented dining areas for the bulk of our quarters. Concerning minimum dimensions of dining areas, it specifies that "Dining rooms or ells should have a minimum dimension of nine feet in two-bedroom units, and *at least six inches should be added for each additional bedroom.*" This is not realistically *people-oriented,* because if a bedroom is added to a house, it means one or more seats at the dinner table, and for that, dimensions should be increased according to people to be seated, rather than an arbitrary increase in square feet. Further, it gives no consideration to entertaining.

Criteria for other areas of the house are not quite as clear-cut as the dining area, but by knowing the number of people to be served and the size and quantity of possessions, we will be better able to establish criteria more in keeping with occupant needs and desires.

Generally speaking, the participants were satisfied with the operation and maintenance of our housing with one noticeable exception; interior paint. A considerable number of occupants find the interior paint inadequate. NAVFAC paint experts insist our paint specifications are adequate; therefore, somewhere in-between our paint specifications and our occupants' care of painted walls, lies a considerable discrepancy. This will be investigated.

After taking such care to get reliable, representative information, just what will be done with the results? To best respond to our occupants' needs and desires, the survey results will be considered and applied where possible to support changes in the future.

Data Processing Trends

• Alexandria, Va.

In recent years, the ADP services provided to many NAVFAC System Proponents have significantly increased. This increase reflects NAVFAC managers' continuing effort to provide stable and increased levels of effort in the face of ever diminishing resources. Similarly, the increased ADP services are being provided without correspondingly increased expenditures. Total command ADP funding has remained at a relatively constant level since 1969 even though inflation has seriously eroded the buying power of the funds. NAVFAC ADP personnel staffing peaked at 428 in 1971/72 and has since declined to 365. The ability to provide more ADP services with lessening resources is due in large part to the continuing effort to procure the optimum mix of computer equipment and software at the least cost.

Major ADP Resources

NAVFAC's largest ADP equipment resource is the Facilities Systems Office (FACSO), CBC Port Hueneme, with its IBM 360/65 computer which is leased from a third party computer leasing company at a price 35% less than that available from the manufacturer. With its million positions of core storage, the 360/65 has computing power to process all CBC and engineering field division business and logistic requirements as well as to work for other Port Hueneme tenant activities. FACSO is staffed for two full shifts five days per week, with a skeleton staff to process any remaining work during the third shift.

A most important ADP resource is the data telecommunications network by which FACSO provides data transmission service to the CBCs and the continental U.S. EFDs Transmission terminals not only send and receive the reports, but also control the card processing and printing operations for the activities.

FY73 Accomplishments

The CONUS PWCs and PWC Pearl Harbor are supported by Honeywell H-200 computers. PWC San Diego has full operational control over its computer operations, while those for the other PWCs are operated by other naval activities. PWC Subic Bay and PWC Guam get their ADP support on shared Burroughs B-3500 computers which are managed and operated by naval ADP service centers.

Equipment actions during the past year have been particularly rewarding. Space limits the list to major items.

In October 1972, the powerful 360/65 computer replaced a smaller 360/50. Although the new computer is more expensive, its cost was more than offset by enabling FACSO to undertake the processing for Pacific Ocean area activities, and by the discontinuance of extensive contractual ADP processing. The centralization of the POA data processing support at FACSO permitted NAVFAC to turn over its Bangkok Computer Center to the Department of State at an annual cost reduction of $252,000.

Twenty-three FACSO tape drives were replaced by 16 more efficient units, at a saving of $42,000 per year and providing faster tape operations.

During the year, the data telecommunications network was upgraded to break the transmission bottleneck. Although this action increased expenditures by $74,000 annually, it eliminated the need to increase operations personnel at a greater cost.

FACSO's old keypunch operation fell victim to a new key-to-disk-to-tape (key entry) system. This faster and more efficient system saves in excess of $42,000 per year. (See p. 18, Spring issue of The Navy Civil Engineer.)

Negotiations with suppliers resulted in a price reduction of $40,000 per year in FACSO core storage rental costs.

In the Pipe Line

The pursuit of better equipment and lower costs continues. Planned actions will lead to additional improvements.

Direct on-line ADP support for PACDIV is scheduled for August/September 1973. PACDIV will receive the first Remote Job Entry (RJE) terminal in the NAVFAC family. (See p. 21, Summer issue, The Navy Civil Engineer). This RJE will use a shared data telecommunication line to hook up to the FACSO 360/65, and will provide PACDIV with the processing responsiveness it required.

During July and August, FACSO's 32 random access disk units were replaced with 12 new larger units. Not only will NAVFAC save $50,000 annually but the new units operate faster and provide an increase in on-line disk storage from 928 million to 1.2 billion characters.

Cathode Ray Tube (CRT) terminals will be installed at FACSO in the fall to increase the efficiency of the 360/65's operation. These CRTs will reduce costs by $32,000 annually.

A second million "bytes" of core storage is planned in order to significantly decrease computer programming time through the use of on-line computer-aided programming, and also to enable FACSO to provide sophisticated time sharing service to headquarters and the EFDs that is now contracted at a cost of $188,000. An annual $49,000 saving is anticipated. A greater, but as yet uncosted, benefit will be realized when this core is also used to process scientific work for other FACSO customers.

Remote Job Entry (RJE) terminals like those provided to PACDIV are being planned for the CBCs and the CONUS EFDs' The RJEs will improve the ADP transmission time by an estimated 35%, and result in equipment and operator savings of $47,000 per year. This action is targeted for the summer of 1974.

The navy is committed to GSA to competitively replace FACSO's 360/65. This long term project was originally scheduled for completion in December 1974. However, CNO has been requested to include FACSO in a single procurement action for computers for several naval activities. This will delay the replacement until some time in 1975/76, but will result in the acquisition of a computer adequate for NAVFAC/FACSO needs into the 1980s at the lowest possible cost.

Funding constraints make it imperative that NAVFAC obtain greater computer processing capability out of each dollar to expand service and to offset the significant effects of inflation.

Rapidly changing ADP technology is continually screened to assure the acquisition and use of the most cost effective equipment. Use of competitive procurement procedures is producing the best possible prices. The ingenuity of NAVFAC and FACSO ADP personnel has and will continue to result in the best possible operational procedures. This command's ADP accomplishments are widely recognized throughout the navy. The job is to maintain and improve upon this reputation.

By JOHN N. DANO
Hardware Specialist

Advanced Base Design Shared by Armed Services

By R. R. SCHAAF
Head, ABFC Branch, NAVFAC

• Alexandria, Va.

The Advanced Base Functional Component (ABFC) System was developed during World War II for tactical and logistics planners as a tool for procuring and distributing the material and equipment required by the military commanders on a priority basis while they were exploiting a changing military situation. This required an enormous effort at all levels.

It was found that this could be best achieved by identifying the recurring basic *functions*, and determining what was required to perform each task. The concept contained *components* to serve a specific function no matter where it was placed. The *components* have become, in the ensuing years, the quantitative measurement of planning, procurement, assembly and shipping of material, equipment and men needed to satisfy emergency facility construction support requirements overseas during wartime and contingency operations.

A functional component, as developed, is a grouping of materials, equipment, drawings and/or military personnel designed to perform a specific task or base function. It includes a bill of materials, drawings, and the personnel complement for specific facilities. It provides a ready source of facility planning and direct end-item procurement data, special functional equipment, tactical support facilities, integral logistic support and construction information.

The primary goal of the ABFC system, however, is to provide comprehensive information to the planner — not the actual delivery of hardware.

The components in the ABFC system have not been thoroughly updated since World War II. Neither do they reflect organizationally the construction and combatant forces of today's navy. Some components have been added and some deleted, but in the main, they reflect the construction materials, equipment and techniques then existent.

Admiral Kidd, chief of naval material, in his memorandum of 1 September 1972 to all systems commands, directed that the ABFC System be updated by 1 July 1974. The first steps in the update procedure have been taken. A detailed study has been made of the missions of the individual components to determine whether or not they fit in with the mission and organization of today's navy. As a result, the total number of components has been reduced from 330 to 203. The task now remains to bring these remaining components up to "the state-of-the-art" by 1 July 1974.

The design/redesign effort requires: new/revised advanced base drawings for inclusion in NAVFAC P-140; bills of material (to federal stock number (FSN) level); labor estimates for Seabee construction; cost estimates; and detailed facilities listings for NAVFAC P-437, "Facilities Planning Guide." Mission statements, personnel complements, cross reference data, cost data, construction data, and material and equipment requirements are also needed for inclusion in OPNAV 41P3, "Table of Advanced Base Functional Components with Abridged Initial Outfitting Lists."

All of this effort is shouldered by the Civil Engineer Support Office (CESO), CBC Port Hueneme, California, NAVFAC's advanced base facilities design and procurement agent.

The army and the air force have their own systems, similar to the navy's ABFC system. NAVFAC's counterparts in the army and air force have been contacted to determine the status of their efforts in advanced base facilities design. Initial contacts were so promising that a coordinating conference was held in February 1973 at the Construction Battalion Center, Port Hueneme, attended by representatives of NAVFAC, marine corps and army engineers headquarters, Air Force Civil Engineer Center, Air Force Bare Base Systems Office, Navy Civil Engineering Laboratory and CESO. Significant developments from the conference were:

Accepiance of designs: (1) The Navy will accept the air force "bare base" airfield lighting set specification for direct adoption into the ABFC system; (2) the Army will accept the navy's new advanced base medical and dental facilities components designs for direct adoption into its AFCS system at a saving of over $2,000,000 in design costs to the army; (3) the Navy's panelized building, for which a MILSPEC is being prepared, will be accepted by the army and air force as the first generation advanced base building; (4) the air force's Rensselaer Polytechnic Institute (R.P.I.) building system will be accepted by the navy and army as the second generation advanced base building; (5) the navy's P.O.L. designs, now being developed by A&E contract, will be accepted by all services; and (6) the navy's ammunition magazine designs will be accepted by the army and air force.

Design assignments. The following design assignments were made, the products of which will be accepted by all services: (1) sewage treatment — army; (2) aircraft shelters — Air Force; (3) confinement facilities — Army; (4) containerized port facilities — Army; (5) water treatment (purification) — Army; (6) water treatment (desalinization) — Navy.

POL Transfer/Storage assignments are: air support (0-6 mos.) tactical — Navy; fixed base — Air Force; 6 mos. + — Air Force; storage and secondary distribution — Navy; amphibious/port (0-6 mos.) — Navy; 6 mos. + — Army; and long haul — Army.

Administrative and Fundings (1) administrative procedures have been established whereby each service's design requirements will be included in the scope of all design work; (2) technical information and reports developed as a result of research or single-service design effort will be passed on to the other services, and (3) services will contribute their share of funds to the others' design effort. Navy and army have already contributed $10,000 each to the air forces' RPI building study, and the army has contributed $435,000 to the navy's advanced base medical and dental facilities contract for the development of bills of material and labor estimates.

The last conference of the group was held this summer at the Army's District Engineer Office in Norfolk, Virginia. Quarterly Newsletters are published to keep the members of the group apprised of current developments.

The results of the work done thus far by this inter-service cooperation are very encouraging, and promise to benefit all services, both by saving design effort and funds and by improving the technical quality and readiness of the ABFC System.

BUILDING CODES vs. DESIGN STANDARDS

ARE THEY COMPATIBLE?

By J. V. TYRRELL, P.E.
Chief Structural Engineer, Design Division, NAVFAC

• Alexandria, Va.

One of the functions of the Naval Facilities Engineering Command is to develop and maintain criteria for design and construction of naval shore facilities. To the greatest extent possible, recognized national standards such as those developed by the American National Standards Institute or industry groups are used as basic references. Additional guidance is provided to assure compliance with the laws governing military construction, to establish uniform quality and to accommodate requirements unique to the mission of the navy.

Over a period of time, a considerable body of criteria has been developed by NAVFAC. Maintaining these criteria requires a substantial effort which, though very small compared to the total construction program, does have a cost. This cost has been reduced, however, by development of tri-service criteria in cooperation with the army and air force. For such development, the Department of Defense appoints one of the agencies as manager for a specific portion of the criteria and a working group is formed to coordinate with the other agencies.

Another development has been the trend toward government-wide uniformity of criteria through voluntary cooperation between agencies participating in the Federal Construction Council of the Building Research Advisory Board, National Academy of Engineering. The council's efforts are leading to greater uniformity and, by avoiding duplication, should lower the cost to all involved.

While these efforts to avoid duplication within the government, and consequently, to reduce costs, are universally applauded, some may ask why any navy or government criteria are necessary. After all, engineers, designing for private clients, somehow get along without the government criteria. Obviously, the portion of the criteria directly related to statutory and administrative requirements could not be eliminated, but it is not unreasonable to inquire if certain portions could be left to building codes, industry standards and engineering judgment.

To determine answers to these questions NAVFAC, in 1971, decided to take a broad look at this proposition and to compare navy criteria to that which would be used in connection with construction for the private sector by making parallel design investigations for specified projects.

Since private construction is governed by building codes, it was decided to make such a code the basic criteria reference. A preliminary examination showed that there is a wide variation in the requirements of various local codes which would pose a problem of maintaining uniformity in quality. The study also demonstrated that maintenance and updating of local codes is highly irregular. Therefore, one of the widely accepted national or regional codes appeared to be more pertinent to the navy's needs. The Southern Standard Building Code (SSBC) was selected for a detailed investigation. This choice was made because the SSBC appeared to be a typical regional code used in the area where a trial was contemplated, and the local A&E firms were said to be familiar with its provisions. Four projects to be designed and constructed in the area served by NAVFAC's Atlantic Division were selected for examination. The objectives of the study were to compare quality requirements, impact on construction and design costs, and to gain insight as to the value of NAVFAC criteria to A&E users.

The A&E contracts for design of these facilities contained a provision that the A&E provide a comparison between the building code and NAVFAC criteria with respect to the study objectives. A different A&E firm was selected for each project to insure that the study would have a broad perspective. Unfortunately, two of the projects selected for investigation subsequently were dropped out of the MCON program. The remaining two studies were completed by March 1973.

The studies revealed few specific differences between the two sets of criteria that resulted in major cost impact. One exception was the fire protection required for a cold storage warehouse structure. The protection required by the SSBC was estimated to be $126,000 more than it would cost to meet the NAVFAC requirements. In general, there were few appreciable cost differences but NAVFAC criteria did result in lower costs in both studies. Although small, the estimated difference in construction cost, if averaged for the MCON program would easily pay for the cost of maintaining design criteria.

Of course, two studies are insufficient to demonstrate a difference in construction costs. Furthermore, there is an obvious inter-relationship between criteria, construction cost, and quality that would preclude evaluation of criteria on the basis of construction cost. Nevertheless, these studies do reasonably disprove the idea that NAVFAC criteria add unnecessarily to construction costs because of overly conservative or outdated requirements. The most significant finding was that the SSBC does not cover many items. Instead, the code in some cases refers to decisions by the "building official" or leaves the decision entirely to the designer. Since uniformity in government construction is necessary for many reasons, and in fact, often demanded by the Congress, the Southern Standard Building Code could not be used without considerable supplementary guidance.

The SSBC building code provided guidance oriented toward health and safety requirements, with emphasis on fire protection. The NAVFAC criteria was found to be more comprehensive from a design standpoint, more detailed in the scope of design coverage and more explicit. These characteristics of NAVFAC criteria not only establish quality standards, but were found to be helpful to the designer. While this help is valuable, the study could not quantitatively relate this to the cost of design.

In view of the findings of these studies, it is concluded that maintenance of NAVFAC criteria is desirable and cost effective. Continued cooperation and coordination with other government agencies offers the best possibility of reducing both the cost of maintaining criteria and the cost of design. Perhaps a study should be made to determine if government construction does, in fact, cost more than *comparable* private construction. Comparability is the key factor, and any evaluation would involve some judgment as to the appropriate level of quality for the intended use of the facility. It it can be shown that government construction costs more, then possibly our contractual boiler plate, specifications, and construction inspection procedures should be examined for their respective influences.

Transportation Equipment Management Revised

By S. J. WALL
Director, Transportation Equipment Division, NAVFAC

• Alexandria, Va.

Realignment of the NAVFAC-managed navy transportation equipment program from a geographic to a command (claimant) basis became effective 1 July 1973. Almost three years of planning, reorganizing and program rewriting preceded the realignment.

The final NAVFAC decision on the type of realignment was influenced by two prime considerations: first, how to most effectively interface with the unilinear navy; and, second, how to retain a hard-core cadre of technical personnel in an organizational element that was rapidly being decimated by personnel constraints and retirements.

The basic need for all logistic programs to be compatible with the claimant chain has been increasingly evident from the onset of implementing the revised General Order 5 on 29 April 1966. Prior to this revision, the navy operated under a bilinear organization wherein the operating forces and the logistic support activities reported to the secretary of the navy through separate chains of command. With the reissue of General Order 5, the chief of naval material (CNM), the chief of naval personnel and the chief of the bureau of medicine and surgery reported through the chief of naval operations. The resulting unilinear structure placed the material, medicine, and personnel support elements, along with the operating forces, under the direct control of the chief of naval operations.

As part of the reorganization, the naval material command was activated 1 May 1966 and all systems commands were placed under it. An important feature in implementing the revised General Order 5 in the logistics area was that the control of all expense and the distribution of resources was through the chain of command. In operating under this realignment, the commands responsible for funding transportation equipment maintenance expenses were of the opinion that they should also have control over field activity allowances. The navy inspector general, in inspecting the 11th Naval District in April 1971, concurred in this philosophy and recommended realignment of transportation equipment allowances from the area coordinators to the claimants.

The final realignment decision was preceded by a number of related changes. In a consolidation move, all data processing of transportation equipment requirements and budget data was transferred to CBC Port Hueneme on 1 July 1971. Concurrently, SECNAV directed the integration of the separate transportation equipment reporting systems with the navy's in-use capital asset reporting system (plant account).

Studies connected with implementing the allowance realignment decision indicated that it was not possible to effectively separate allowances from the transportation technical support functions.

Clearly indicated was the need to provide staff technical assistance to claimants in close proximity to their headquarters. In specific response to this requirement, special technical service organizations, designated as Transportation Equipment Management Centers were formed in the NAVFAC field division offices at Norfolk, Pearl Harbor, Chesapeake and Pensacola. All were contiguous to the claimants except CINCUSNAVEUR (London) and COMNAVRES (New Orleans), which would be served on aremote basis by Norfolk and Pensacola, respectively. Resident technical assistance to activities in the 11th, 12th and 13th Naval Districts is provided by a WESTNAVFACENGCOM transportation organization working in conjunction with the transportation equipment management centers.

Leisure Time Center Planned For Texas Air Station

By WILLIAM C. SUITE
Architectural Specialist for Hangers, RDT&E and Community Facilities, NAVFAC

• Alexandria, Va.

An in-house design study has been prepared by NAVFAC architectural branch for a leisure activities complex for NAS Kingsville, Tex. The proposed design will centralize and consolidate all club and recreational activities. Within this complex, there will be officer's and enlisted men's clubs (each with pool and bath house facilities), theater, bowling alleys, arts and crafts, auto hobby shop, youth center, lodge, package store, outdoor athletic and sports areas, and parking for 600 cars.

All facilities will be within a short walking distance of each other. A U-shaped driveway will provide automobile access to each building. Major parking will be peripheral, with some central parking near the clubs and recreation building.

The consolidation of several activities into one structure conserves land and is more convenient for both participant and spectator. These combined facilities include the gymnasium, theater, bowling alley, recreation, arts and crafts, and auto hobby shop.

The proposed design for the EM Club is unique because it serves grades E1 through E9. The plan is extremely flexible and functions especially well for a large attendance when spectacular shows are presented. By removing all folding and portable partitions, nearly all seats will have a direct view of the stage.

The design also features a gourmet dining room which will specialize in exotic and special cuisine and will provide waiter service. On a mezzanine above will be a cocktail lounge. Other features will be another large dining room with cafeteria service, a regular bar, a stag bar, a large ballroom and multi-use areas. The latter can be arranged in a variety of shapes and sizes by the use of sliding and moveable partitions to provide space for meetings, cards, games, private parties, etc. There will be well-planned and landscaped outdoor gardens and terraces off most of the rooms.

The design effort, the innovations and the planning of this complex are another significant contribution by NAVFAC to Admiral Zumwalt's policies and programs to improve recreational and living facilities and thereby enrich the lives of all naval personnel.

Plans for the E1 through E9 Club are nearly completed and construction should start in early 1974.

PESTICIDE DISPOSAL

By ARTHUR BRANNAN, JR.
Entomologist, Atlantic Division

• Norfolk, Va.

In recent years the chlorinated hydrocarbon family of pesticides, particularly the insecticides developed in the 1940s and 1950s, has been restricted in use. Since 31 December 1972, the use of DDT has been prohibited in the United States and in U.S. Government installations overseas. Unusable or surplus stocks of these items have been stored at naval activities and Defense Supply Agency disposal offices awaiting proper disposal instructions.

Notwithstanding the fact that these pesticides are very persistent in the environment (their principal objectionable characteristic), many of their concentrate formulations have limited shelf life. Therefore, many of the chlorinated hydrocarbon insecticides are no longer usable for their original intended purpose, as their shelf life has expired.

As required in the Federal Environmental Pesticide Control Act of 1972, the Environmental Protection Agency has promulgated disposal procedures which were published in the *Federal Register*, Volume 38, Number 99, Part II of May 23, 1973. The recommendations state that the most desirable disposal technique forusable pecticides is to use them in accordance with their labelled intent. An alternative is to return them to the manufacturer, if he will accept them. A third alternative is to export them to a country in which their use is desirable, effective and legal. The final recommendation for disposal is destruction of the pesticide.

The preferred method of destruction is incineration, which can be performed by anyone capable of meeting the incineration criteria promulgated by EPA. Incineration destruction is not suitable for pesticides containing heavy metals — mercury, lead, cadmium, arsenic — until these metallic components are removed from the compound.

If the pesticides cannot be incinerated, disposal in specially-designated landfills is suggested, or encapsulation is recommended for pesticides containing heavy metals and for certain inorganic materials which are highly mobile in the soil. However, disposal in landfills and the encapsulation operation are complicated procedures considered the least desirable for disposal. Before disposal procedures using landfills or encapsulation are attempted, contact the cognizant entomologist for advice. Other methods of pesticide disposal are under investigation and acceptable techniques and procedures will be recommended as they are developed.

Proper disposal of containers is a problem brought about by use or destruction of the pesticide contents. This problem can become acute even before disposal of the contents when deterioration of the container causes a threat to the environment. When a container is leaking, repackaging the pesticide is required in most cases (immediate incineration may be possible under certain conditions). Unless correct new containers are used and proper transfer techniques are employed, the pesticide may be rendered worthless for its intended use. An emptied pesticide container should be rinsed with the correct solvent or diluent so that the pesticide residue is removed. The liquid waste used in rinsing must then be packaged and disposed of in the same manner as that recommended for the pesticide itself. The rinsed, clean containers are no longer classified as pesticide hazards and may be disposed of in any conventional manner. The area contaminated with the leaked pesticide must be completely cleaned and the residue disposed of in the same manner as that recommended for the pesticide.

Questions regarding disposal of pesticides or pesticide containers should be directed to the cognizant entomologist.

Renewal of Pierside Electric Services

By R. D. CROWSON, P.E. and A. J. HANSEN, P.E.
Electrical Engineers, Utilities Div. LANTDIV, NAVFAC

• Norfolk, Va.

Taking advantage of advanced technology in the design and manufacture of transformers and high voltage switchgear, engineers of the Atlantic Division, Naval Facilities Engineering Command have developed an approach for providing electrical power to ships at the Naval Station, Norfolk piers which will reduce both the installation and operating costs of the facilities.

Under current practice, pier substations are supplied at 11.5KV, which is the principal distribution voltage for the naval station complex. A 34.5 KV system, which supplies power to the 11.5 KV distribution through a number of 20,000 KVA substations, serves as a sub-transmission system for power received from the commercial supplier.

The new approach extends the 34.5 KV system onto the piers for transformation directly to the utilization voltage, thus eliminating the investment and operating losses, attendant with the intermediate transformation stage.

On a recent military construction project, which involved doubling the existing transformer capacity on two naval station piers, the additional load on the 11.5 KV system would have required an additional 20,000 KVA 34.5 KV to 11.5 KV substation transformer. Additionally, the project, as written, did not entirely eliminate the deficiency on one of the piers, thereby necessitating a future military construction project for final correction.

Under the new plan, the existing 11.5 KV substations will be relocated from one pier to the other, new 34.5 KV substations of sufficient capacity to correct the entire deficiency will be installed on the vacated pier, and the 20,000 KVA 34.5 KV to 11.5KV substation installation will be eliminated. The results are an immediate savings of $378,900 on the current MILCON project, the avoidance of a future investment of $250,000 for additional facilities, and a savings of $176,000 in system losses over the 20-year life of the facility.

This same philosophy is applied to other pier utilities projects and to other large load concentrations as appropriate; additional dramatic savings can be expected.

'Instant' Housing Referrals Featured At CBC

By EILEEN E. GREENE *Director, Housing Division*
• Port Hueneme, Calif.

The Housing Referral Office of the Naval Construction Battalion Center, Port Hueneme, provides rental housing service to all military personnel residing in Ventura County. Computer listings cover the area encompassing a 50 mile radius of Port Hueneme. The total number of listed housing units is approximately 25,000, and the Housing Referral office makes approximately 2,000 referrals per year.

Individual listings include mobile home units, 1 bedroom, 2 bedroom, 3 bedroom units and realtor rentals for 4 bedroom or unusual units. The lists are updated monthly to reflect changes in rental rates, landlords, telephone numbers, etc.

A landlord listed with the Housing Referral office has only to call and advise the office of the vacancy and give the telephone number. The last four digits of the telephone number provide quick reference to the automated listing, which shows such information as rental rates, deposit, utilities, children, pets, appliances, etc. This eliminates the time-consuming process of obtaining these details from the landlord each time.

This method permits the Housing Referral office to maintain complete housing rental information in a compact 8½ x 11 inch book form of approximately 50 pages. One of the principal advantages lies in being able to glance down the page for a quick answer when a particular need exists, e.g., does an apartment allow pets.

Super Battery — East Coast RPG — Now Operational

• Ft. Belvoir, Va.

On June 1, 1973, Rear Admiral John R. Fisher, CEC, USN, then acting Vice Commander of the Naval Facilities Engineering Command, cut the ribbon to officially open the navy's East coast Radioisotope Power Generator (RPG) Surveillance Facility at the Naval Nuclear Power Unit, Fort Belvoir.

Nicknamed "Super Battery," the RPG produces an electrical output from the heat developed by a sealed capsule of radioactive waste material. This heat is directed through a series of thermoelectric junctions to directly generate electrical power. The RPG provides a highly reliable, maintenance-free power source that will operate continuously unattended for periods up to 20 years.

RPGs have been utilized in a wide range of applications, from the vacuum of outer space to the tremendous pressures of deep ocean use. Navy applications include various acoustical beacons, scientific data gathering, and automatic weather stations. The U. S. Navy currently is the largest known user of RPGs.

In an address to the guests and visitors, Commander George M. Gans, Jr., CEC, USN, director of the Nuclear Power Division of the Naval Facilities Engineering Command, stated that RPGs will be used in larger and larger numbers in operational missions in the future.

There are many remote and inaccessible places where electrical power is needed for fleet-oriented equipment. The development of cost-effective, reliable, and long-lived radioisotope generators is helping to solve power problems for this sort of environment.

Environmental Impact Statements

Advice of Counsel

A dozen statutes and two dozen executive orders and reorganizations, plus innumerable regulations and instructions, have profoundly changed the way Federal agencies can undertake procurement actions and the Constitutional structure of those actions.

The most important requirement is that of The National Environmental Policy Act, directing that "all agencies of the Federal Government shall . . . include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the ressponsible official on:

(i) the environmental impact of the proposed action,
(ii) any adverse environmental effects which cannot be avoided should the proposal be implemented,
(iii) alternatives to the proposed action,
(iv) the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and
(v) any irreversible and irretrievable commitments of of resources which would be involved in the proposed action should it be implemented."

This famous, or infamous, Environmental Impact Statement, poses the problems of what actions significantly affect the environment, at what stage the statement should be prepared, whether the statement is required on continuing actions, the scope of the investigation, and the effect of non-compliance. The statement must be made available for comments usually in public hearings and must be submitted to the Council on Environmental Quality. Environmental groups bring actions to halt projects for failures to prepare E.I.S.s, or inadequate statements, or improper reviews of such statements, and NAVFAC has been a defendant in two such suits.

Federal agencies have been exempt, by virtue of their position in the higher Federal level of government, from complying with state and local legal requirements; but the environmental laws themselves now require such compliance. The Clean Air Act reads:

> "Each department, agency, instrumentality of the executive, legislative and judicial branches of the Federal Government . . . shall comply with Federal, state, interstate, and local requirements respecting control and abatement of air pollution to the same extent that any person is subject to such requirements."

Similar requirements appear in the Water Pollution Control Act, adding "including the payment of reasonable service charges" and the Noise Control Act of 1972. See also Executive Order 11504 of 4 March 1970. Where Federal agencies used to comply with local requirements as a matter of comity or courtesy to set a good example, they now must comply as a matter of law.

Federal agencies may not enter into contracts with those convicted of violations of the Water Pollution Control Act, if to be performed at facilities in violation; but this obligation has not yet been implemented.

These new requirements pose the problems, still not solved, of how to comply when action depends upon authorizations or appropriations or procurement requirements that preclude timely action, the extent to which Federal agencies should seek licenses, permits, and permissions and variances required by local law, and the sanctions that may be imposed upon Federal officials.

Construction Training By Army Engineers

By ANDREW J. O'REILLY, JR.
Construction Engineer, NAVFAC

• Alexandria, Va.

The changing construction technology added to our reduction in manpower, tolls the bell for the one man-one field expert. We can no longer think of construction as a sequential operation but, rather, as one of interlocking, supporting systems, acting in unison to achieve the designed function. Our construction personnel must be cognizant of the whole spectrum of construction technology. As it develops and becomes more advanced and complex, the need for training, "to be in step," is paramount.

Since 1971, NAVFAC has participated in a construction training program conducted by the Army Corps of Engineers. These courses have not only increased our technical "know how" but, by free exchange of experiences, solutions to individual problems are found to have been resolved elsewhere.

Training courses offered cover major facets of the construction field from asphalt, concrete, painting, welding, hardware, refrigeration, electrical and mechanical inspection through network analysis, contract administration and negotiating techniques. The course material and instruction are not static but are in tune with changing technology. Question and answer seminars, accompanied by well-planned lectures, permit full involvement of each trainee. Comments received speak well of this method of instruction, which permits free exchange of ideas. Enrollment in these courses is open to all navy and marine corps personnel. In FY 71 there were 162 attendees, 311 in FY 72 and 217 in FY 73. Attendees included personnel from public works centers, CBCs, and U.S. Marine Corps, as well as NAVFAC, EFD, and ROICC personnel, representing all areas of CONUS and overseas.

The training in construction and other related fields is an investment which is producing dividends not only in construction techniques and management but also in career development. We should recognize that expenditure of training dollars to increase productivity and attain better construction is economically feasible, even in the face of a limited budget. The navy deserves our best, its people should not be out-classed because of a lack of responsiveness to the demands of present day technology.

Active Duty Training Becomes Mutual Payoff

By FRANK T. TRIPPI
Assistant Director,
Systems Analysis Division, NAVFAC

• Alexandria, Va.

The Assistant Commander for Facilities Planning at NAVFAC headquarters has, for the past 18 months, pursued a very aggressive program of utilizing Naval Reserve officers during their annual 2 two-week active duty training tours. To date, eight reservists — mostly CEC, and ranging from Chief, Data Processor Technician through Captain — have served in the Code 20 area.

The Reserve Program Branch at NAVFAC Headquarters is continually alert to the availability of reservists with education and professional skills in the scientific and technical areas — these include urban planners, mathematicians, civil engineers, logisticians, systems analysts, computer programmers, and operations research analysts, most of whom also possess engineering backgrounds. And, the civilian firms these individuals are associated with have been most varied — one is the largest aircraft manufacturing concern on the East coast; another is an associate professor at a small New Jersey college; and one even heads up a prestigious architectural and engineering firm in the South.

Success of this program can largely be attributed to adequate planning. More specifically, upon notification of a reservist's availability by the Reserve Program Branch, the requesting Code 20 Division immediately contacts the reservist. He is sent material on the project(s) he will be working on, for familiarization prior to his actual arrival on TAD. This is done for a number of reasons: for the reservist, his entire tour on-board is planned to the end that the greatest possible training benefit accrues to him; for the command it minimizes the amount of time lost in "starting-up."

As another example of the benefits accruable to both reservists and NAVFAC under this training program, an on-going project instituted this fiscal year involves seven reserve CEC officers who have volunteered for 60 days extended training duty in July and August and have been assigned by respective District Program Officers to cognizant NAVFAC EFDs to conduct engineering evaluations of selected surface reserve activities throughout the U. S., and prepare the necessary planning documentation to support military construction programming where required.

In summary, the Assistant Commander for Facilities Planning has benefited greatly from the initiative and exemplary efforts of this added and much-needed professional capability, all the more significant in this era of declining manpower resources throughout the active navy forces.

CRYOGENIC

• Alexandria, Va.

CRY•O•GEN•ICS: the branch of physics that relates to the production and effects of very low temperatures.
— Webster's Third New International Dictionary, G. & C. Merriam Co., Springfield, Mass., 1968

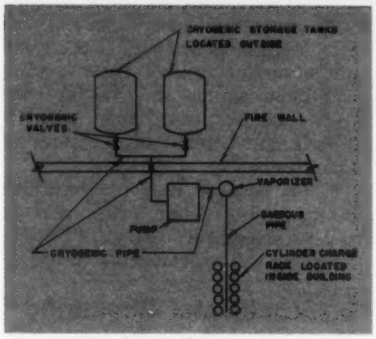
The National Bureau of Standards considers temperatures below −240°F to be cryogenic. Matter which are gases at normal temperatures become liquids at cryogenic temperatures. These liquids are so cold that they constantly boil from heat transferred to them from their surroundings. Liquid oxygen (LOX) and liquid nitrogen (LN_2) boil at −297°F and −320°F respectively.

In uninsulated containers, these liquids boil away very quickly. Even containers with good, conventional insulation such as polyurethane foam are inadequate for long-term storage. The development of vacuum-jacketed tanks and pipe with special cryogenic insulations has made efficient cryogenic storage and transfer systems possible.

In most cases, cryogenic liquids are destined for use as gases, as in the case of aviation breathing oxygen, medical oxygen and welding oxygen. Two advantages of cryogenic liquid are reduced storage space and lower equipment weight. One cubic foot of LOX can be vaporized to 860 cubic feet of gaseous oxygen. Gas cylinders weigh more because of the thick walls required to withstand high gas pressures. The reduced space and weight of cryogenic storage makes it advantageous for large scale uses, especially for aviation breathing oxygen.

The design division of NAVFAC has developed new criteria for navy cryogenic facilities. These criteria are needed because of the increased use of liquid nitrogen and the new LOX/LN_2 generators by the navy. The criteria optimize facility economics and increases personnel safety. The criteria have been coordinated with Naval Air Systems Command (NAVAIR) and with Naval Air Engineering Center (NAEC) in Philadelphia.

The cryogenic storage and transfer systems have been re-evaluated to optimize system economics. The cryogenic system tanks, pumps, pipe, connections, valves and safety devices



Cryogenic piping diagram for separate tanks, pump and vaporizer

have been analyzed and improved, when necessary, to reduce the losses of cryogenic liquids to the lowest level economically possible.

Navy cryogenic liquid storage tanks have had vacuum-jacketed, multi-layer insulation. On a 2000 gallon tank this insulation can keep evaporation losses down to 2% of the contents per month.

However, the total system losses have been much higher. One operator estimates that a third of the cryogenic fluids purchased by his activity are lost when the liquid vaporizes in the piping and safety devices vent the gas to the atmosphere in order to relieve excessive pressures. The heat which evaporates these liquids is contained in and transferred through the pipe, valves and connections. The most effective method of minimizing these losses is to reduce all pipe, valves and connections to a minimum, or, if possible, eliminate them altogether.

When pipe is necessary, it should be lightly constructed to reduce cool-down losses and it should be well insulated to reduce steady state losses. For systems with intermittent use, transient cool-down losses are dominant. These losses can be reduced by reducing the distribution systems through which the cryogenic fluids pass.

In the past, cryogenic pipe has been insulated by expanded foam or material of even higher thermal conductivity. Frequently these insulations have become damaged or stripped off, resulting in extremely high evaporation losses. Vacuum-jacketed pipe, filled with any of a number of insulating materials, can greatly reduce these evaporation losses (see Table 1). Vacuum-jacketing is expensive and occasionally requires re-evacuating: in most applications, however, it is the economical engineering solution.

The navy generates its own LOX and LN_2 where a high quality product is not commercially available. At these locations, the cryogenic liquid is piped from the generator to the bulk storage tank outside. Vacuum-jacketed cryogenic pipe with a minimum of valves and connections is recommended. The bulk storage tanks must be separated from the generation building by a fire wall.

Where LOX and LN_2 of adequate quality are commercially available, tanks, pump, vaporizer and piping have been used as shown in the diagram. The pumps and vaporizers are located in the cylinder charging area in the building, while the storage tanks are located outside and separated by a fire wall.

In 1969, in an effort to reduce the high evaporation losses from these systems, NAVFAC recommended to NAVAIR the use of a packaged system consisting of tank, pump, vaporizer, piping and safety devices in one unit. The packaged unit would be located outside and would require no field assembled cryogenic pipe, therefore evaporation losses would be held to a minimum. The only field assembled pipe would be the gas pipe to the cylinder change rack. These units have the advantages of reduced maintenance, increased reliability and elimination of interface problems which arise when different manufacturers' parts are field assembled.

NAVAIR has installed these packaged units at NAS Oceana and is substituting them for obsolete cryogenic equipment at nine other locations. NAVAIR plans to replace all of the older equipment with packaged units on an "as required" basis.

TABLE I

Approximate Thermal Conductivities of Cryogenic Insulations

Material	Conductivity Btu/hour-foot °F
uninsulated stainless steel	7
expanded polystyrene-foam	2.5X10—2
vacuum-jacketing with powder insulation	7X10—4
vacuum-jacketing with powder and metal flake insulation	2X10—4
vacuum-jacketing with multi-layer insulation	2.5X10—5

Ships Waste Offload System

By C. G. WHITE
Civil Engineering Specialist, Water Treament and Distribution, NAVFAC

• Alexandria, Va.

The Federal laws relating to water pollution control and the regulations of the Environmental Protection Agency have greater impact on the navy than on any other department of the government. The President, in Executive Order No. 11514, called upon the heads of all Federal agencies to initiate measures needed to meet the goals of the National Environmental Policy Act. The Chief of Naval Operations directed that the navy not be content only to meet the national environmental goals, but to do so in such a timely manner as to show the way to others.

The brunt of this new responsibility fell on the Naval Facilities Engineering Command. Early in the program NAVFAC design division let contracts to update sewage and oily waste pollution control criteria, develop criteria for sewer lines on piers, and prepare definitives for sewage transfer systems in graving docks. As tests proved shipboard treatment units incapable of meeting the pollution control requirements, NAVFAC assumed the responsibility of receiving ships waste and transferring it to shore-based treatment plants. To discharge this responsibility NAVFAC design division retained a consulting firm to analyze all feasible means of transferring wastes from ship to shore and to recommend the optimum method for further development. The consultants have recently submitted a report on the first, or conceptual phase of the Ships Waste Offload Systems Study (SWOLS).

The study required an analysis of all feasible means of transferring ships waste to shore. Systems capable of handling all wastes, including oils and oily wastes, sewage, hotel wastes, industrial waste, and solid refuse, were studied. Nuclear wastes, uncontaminated cooling water, and spent shell casings were not included. The contractor was required to rate the systems and recommend the system or systems which merited further study and development. It was required that the systems be composed of "state-of-the-art" components and be capable of being installed and operational by FY 76.

The contractor visited four major naval complexes to accumulate data and observe modes of operation: Newport, R. I.; Norfolk, Va.; San Diego, Calif., and Pearl Harbor, Hawaii.

Fifteen concepts for waste offload systems were analyzed. These were divided into three general classes: surface systems, underwater systems and above surface systems. Each concept was rated on the basis of life-cycle costs and on compliance with 14 criteria considered valid measures of the effectiveness of the system.

Three concepts were recommended by the contractor for further analysis and development: barges, floating pipelines, and environmental boxes.

Environmental Monitoring Thru Navy Data Base

• Alexandria, Va.

The Navy Environmental Protection Data Base (NEPDB) program is a technical support system designed to gather, analyze, and make available to responsible commands environmental protection information. The object is to create a single, centralized service that will support all units — ships, aircraft and shore installations — in their efforts to meet the goals of the navy's Environmental Quality Program. Data will be collected on pollutants of all kinds — including oil, sewage, solid refuse, chemical and industrial wastes, combustion products, and noise — as they affect all media: water, land, and air. This program will assist the secretary of the navy to meet the mandates of Executive Orders 11507 and 11514.

The chief of naval material is responsible, under the chief of naval operations, for the development and operation of the NEPDB system. The Commander, Naval Facilities Engineering Command, under the Chief of Naval Material, is responsible for the management and administration of the system. The Naval Environmental Support Office (NESO) is the executive manager of the system. NESO will coordinate all of the Regional Environmental Support Offices (RESOs). These are located at each EFD so that regional operations can be closely monitored. Each RESO will provide technical support to the district commandants and shore commands on environmental matters.

On 1 July 1973, the NEPDB went operational after two years of research and development effort were spent in defining the problem, developing the technical concept and providing the management structure with which to carry out the program.

The program is scheduled so that full capability will be developed by FY 76. Water monitoring programs will be underway at all major naval activities by the end of FY 75. By the end of FY 76, this will have increased to include all 233 major naval activities world-wide. Routine opacity and stack gas monitoring on specified shore activity boilers will be initiated in FY 75. Routine noise monitoring at shore activities will be implemented between FY 74 and FY 78 to comply with regulations.

The NEPDB System provides the secretary of the navy with a centrally-managed but regionally operated organization to permit him to meet his environmental monitoring requirements in a cost-effective manner.

Two Plastic Materials Deemed Hazardous

By JAMES D. LONG, R.A.
Head, Architectural Specifications Branch, NAVFAC

• Alexandria, Va.

Three years ago, two children died in a Kansas City house fire. The house had been insulated with a spray-on polymer plastic material that had been advertised as "non-burning" and "self-extinguishing." That fire and subsequent fires in the U. S. and abroad have been linked to two plastic materials.

The plastics are cellular or foamed polyurethane and all forms of polystyrene. These materials are used in many different applications, including insulation, lighting fixtures, flooring, wall coverings, panels and siding.

The Federal Trade Commission (FTC) recently charged two organizations and 26 major chemical companies with knowing about, but failing to disclose, the fire hazards associated with the use of polyurethane and polystyrene. The FTC charges include the claim that tests currently used to measure the rate and amount of smoke produced by the plastics, and their toxicity and flammability do not simulate real fire conditions. The organizations and chemical companies — according to the FTC — have thus "misrepresented" the plastics as "non-burning" and "self-extinguishing."

NAVFAC recognized this problem as early as December of 1966 and issued Design Tech Note No. 18, entitled Fire Hazards Classification of Plastic Foam Insulation, indicating that action was planned to eliminate the misleading terminology associated with plastic foam insulations.

Role of the Proponent in the Naval Facilities System

By LT HARRY J. BROWN, JR., CEC, USN
Facilities Systems Office
• Port Hueneme, Calif.

When NAVFAC committed itself to a centralized automated data system, a very complete and encompassing plan was developed. This plan, the Navy Facilities System (NAVFAC P-424), defines NAVFAC's role and efforts within the total Navy Integrated Command/Management Information System (NAICOM/MIS). The NFS plan provides the basic ideas and responsibilities for system development and operation. As much as possible, the individual component systems or programs are aligned to the functional organization of NAVFAC. The program managers (NAVFAC two digit codes) are responsible for appropriate operation and adequate development of the system assigned to them.

The management organization within each system component is established by the program manager. However, certain guidelines have been provided to attain consistency. In this respect, the hierarchy of management control (see Figure 1) as related to the NFS consists of: *NFS proponent, program manager, subsystem proponent, working proponent, and field working proponent.*

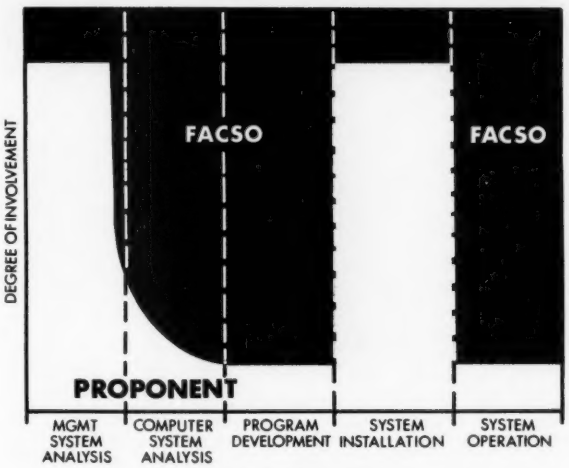
The *NFS proponent* is the commander, Naval Facilities Engineering Command, who is responsible for overall direction and control of the Navy Facilities System.

The *program managers,* referred to as the particular system's proponents, are the NAVFAC assistant commanders responsible for each of the eleven parts of the NFS. The relationships are as follow:

Management Information System	Program Manager
Headquarters/MIS	Director of Programs & Comptroller
Engineering Field Division/MIS	Director of Programs & Comptroller
Construction Battalion Center/MIS	Assistant Commander for Military Readiness
Public Works Center/MIS	Assistant Commander for Operations & Maintenance
Real Property Inventory	Assistant Commander for Planning and Real Estate
Shore Facilities Planning/MIS	Assistant Commander for Planning and Real Estate
Military Construction Program/MIS	Assistant Commander for Military Construction Programming
Civil Engineer Support/MIS	Assistant Commander for Military Readiness
Construction, Automotive & Special Equipment/MIS	Assistant Commanders for: Military Readiness Operations & Maintenance
Public Works Department/MIS	Assistant Commander for Operations & Maintenance
Naval Environmental Quality Data System	Assistant Commanders for: Research & Development Operations & Maintenance

A *subsystem proponent* is appropriate for the MIS which transcends the traditional organizational lines. Systems such as HQ/MIS and EFD/MIS operate in many functional areas and require precise coordination of efforts. The program manager is assisted by experts knowledgeable in the different subsystems which make up a particular NFS component or program. The NAVFAC Systems Division assures that necessary interfaces between programs are established, respected and maintained.

Working proponents handle the more detailed aspects of day-to-day development and/or operation of the NFS. These individuals are the direct agents of the program



managers and as such are the representatives of NAVFAC management. As defined in the NFS, working proponents *"... are primary action agents in the triad composed of program managers/ADP systems specialists/field users with the responsibility of ensuring effective and economical ADP responsiveness to NAVFAC management needs. The working proponent must have expertise in management systems and a good understanding of the advantages, disadvantages, costs and benefits of automation as it pertains to each particular management system."*

Geographical location of a working proponent is important and requires that he be located where he can best coordinate the day-to-day tasks between FACSO and the system user. For some systems, the working proponent at NAVFAC headquarters can provide the necessary coordination. At other times, it is necessary to augment the proponency organization with personnel in the field closer to the customer and/or FACSO. In this case, the working proponent is designated a *field working proponent.*

NAVFACNOTE 5200 specifically identifies the headquarters and, where applicable, the field working proponents by name and code for each of the subsystems processed under the NFS plan. The list is quite extensive and space limitation prohibits reproduction within this article. However, as an example, many of the subsystems which support the work conducted by the Commander for Military Readiness, have a headquarters working proponent within NAVFAC Code 06 and a field working proponent within the Civil Engineer Support Office (CESO) at Port Hueneme. CESO is keenly aware of their responsibility in the evolution and operation of a computer-supported system. They developed the graphical display of the interdependency of effort between the proponent and FACSO. The "proponent" varies by application and may include the combined efforts of the program manager, the subsystem proponent, the headquarters and/or the field working proponent.

As a final point, although other SYSCOMs include the proponency "system" within their ADP organizational structure, NAVFAC considers that development and operation of the NFS require strong functional involvement throughout the command. Therefore, each program manager must be directly involved with management (information) systems in his area of functional responsibility.

ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES · ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES · ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES · ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES · ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES · ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES · ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES · ENERGY SHORTAGE · AIR POLLUTION · NOISE IRRITANTS · NUCLEAR FALLOUT · WIND DAMAGES · SURFACE FIRES · URBAN CONGESTION · IMPAIRED LANDSCAPES ·

is it time to go under ground?

By LT LLOYD HARRISON JR.
CEC, USN

The concern over the threatened shortage of energy in the U. S. has resulted in renewed conservation efforts both in the governmental and civilian communities.

One method of energy conservation perhaps could be found in constructing future subdivisions underground. This article discusses the underground housing concept with respect paid to non-economic and economic considerations.

Subterranean residences have existed throughout man's history. The natural formations occupied by the caveman protected him from the elements and his enemies. Some 5,000 years ago a civilization of agricultural people near Negev, Israel, lived in villages housed in extensive caves dug in alluvial soil along dry river beds.

The Egyptians had a similar community. Both groups used the earth as protection from the extreme temperatures and the windblown sand of the desert. For the last 3,000 years Asia has had a similar underground community located in the loess belt of Northern China. The villages of this community are inhabited by an estimated total population of 10 million inhabitants.

Recently two U. S. architects have made interesting proposals for underground living. In 1956 Paolo Soleri built a partially buried house in Paradise Valley, Ariz. The dwelling included very low construction costs and a low heat/cooling requirement. Soleri accomplished these economies by building a structural network of light-weight cast concrete shells on the desert earth and then excavating the rooms beneath them leaving a frame spanning a pit similar to the basement of a conventional house. The dwelling is cool during the day and retains some of the sun's heat during chilly nights. The arch of the shells allows the sun to provide light during the day.

Then in the mid-sixties, New York architect Richard D. Kaplan designed a 56-acre subdivision near Southampton, Long Island. The houses of his subdivision were covered with a three foot mound of dirt similar to those seen on potato farms. His motive was to show the community that development of this highly desirable area need not destroy the very values that made it desirable. The land could be used for housing and the landscape be preserved.

Neither Soleri's nor Kaplan's proposals were totally underground since each raised the ground level over the house location. This article considers the totally subterranean subdivision of housing units constructed similar to current one-level basements which have been lowered to allow several feet of earth to cover the roof. A person would enter the dwelling by stairs on two different sides of the windowless house. This design has several advantages over that of the surface house. The underground dwelling:

- Forms its own shelter against most natural and man-made disasters. These disasters include tornadoes, airplane crashes, wars, and fires in the adjoining residences.
- Offers additional security against burglary by limiting access to the building interior only through the doors.
- Reduces the effect of vibrating equipment by the 3-dimensional support of the surrounding earth. This could include motors as well as nearby aircraft.
- Requires less exterior periodic maintenance to maintain the neighborhood image since the exterior is buried.
- Isolates the resident from exterior accoustics because of the outstanding sound attenuation characteristics provided by several feet of earth. In this way it would provide a psychological privacy presently unknown to city dwellers.
- Preserves the landscape, which would be interrupted only by streets and entrances. A resident upon emerging would look on greenbelt rather than a series of houses al-

though the dwelling density would be the same.

- Requires less energy consumption for environmental comfort because the earth maintains a 54-degree temperature and low heat transfer coefficient below the frost-line.

Additionally, an underground subdivision offers several possibilities to the planner:

- Since privacy can be maintained with a limited separation between houses, dwelling separation could be reduced.
- The useable yard area would include the area above the house; yard size could be reduced without restricting the resident.
- Smaller lot sizes and smaller house separation would reduce utility runs.

The disadvantages to the underground subdivision are believed to be fewer in number:

- The structure could not be used in an area of high ground water level or in a flood plain.
- Exterior air would have to be brought into the house in a fan duct system for odor free air. Normal surface house infiltration takes care of this requirement. The expense of installation of the system, would be minor.
- The electrical lighting expense of the house would be increased by one-third due to the lack of exterior light.

Areas of potential seismic disturbance would require substantial structural reinforcement or would preclude such dwellings.

- Some individuals react against a windowless environment, even though there is no apparent difference between a windowless office in a building interior and one under the ground. This is the most difficult complaint to quantify.

From this review of the non-economic aspects of a buried subdivision it can be seen that this design would be particularly advantageous around airfields and in areas of extreme temperatures. The buried house would protect the residents from aircraft accidents and noise, as well as reduce the number of distracting lights to the aircraft crew at night. The excellent insulation quality of the earth provides a significant heat/cooling savings in an extreme temperature environment.

The economic considerations fall into three areas: construction costs, utility construction costs and energy consumption costs.

To make a comparison of these costs, a 1500 square foot (30 foot x 50 foot) single-level residence design was used. The design temperature and degree days were those of Denver, Colorado. Construction costs were determined through use of the *1972 Richardson Engineering Services Construction Estimates Standards*. Heat transfer coefficients came from design tables in *Mechanical Equipment for Buildings* by McGuinness. Current Colorado energy rates were used, and equipment prices came from the Trane Company. The estimates were based upon four inhabitants.

With respect ot the construction costs there were several areas worthy of note, yet not actually counted. Buried houses do not require exterior finishes as do surface houses, nor are there windows or veneer sidings to apply. Recently forming methods have been developed employing the earth as one side of the concrete forms, and reducing the forming costs. Basements generally provide their own foundation support, whereas basementless surface houses require trenching below the frostline for foundation footings. Since underground houses cannot be seen from the road, it is also possible to obtain a greater savings by repeating each house design.

A construction estimate showed the buried design to cost $7365 and the surface design to cost $7413. In estimating the comparative costs of the two designs, only the features that were unique to each were actually calculated. The internal features of each were considered to be the same. The two U. S. architects disagreed slightly on this point. Soleri indicated a greater savings for the buried design, whereas Kaplan believed it to be slightly more expensive based on soil stability problems of his partially submerged houses. Since local conditions could cause a greater influence on these costs, the construction costs for the two houses are considered generally equal.

The buried house had an additional utility construction cost caused by the lowering of the house. Since this is considered on a subdivision scale the entire utility functions were lowered including the street main. The utility most affected was the sanitary house sewer, and its street main. The water and electrical line did not need to be lowered. Estimates of the cost of lowering the sewer from eleven to fourteen feet varied from $1.80 to $4.00 per linear foot of sewer line.

If each house is held responsible for eighty feet of sewer the additional utility costs of building underground should run between $144 and $320 depending upon the type of soil involved. These figures indicate an average additional initial utility cost of $232 per house in the underground subdivision.

The most significant economic difference between these two designs is in the area of energy consumption. As mentioned earlier, the design characteristics and rates are based upon an average 1500 square foot house in Denver. The required energy analysis of each design indicated that the buried house consumed only 28% as much energy as the surface house. Since the odor-free air requirement 25 CFM/PERS) consumed 60% of the energy utilized in the buried design, it can be seen that the heating of the incoming air is the largest single energy consumption factor of that design. The results of the energy requirements are:

Subject	Surface Design	Underground Design
Winter Heat Loss(BTUH)	39,927	12,720
Summer Heat Gain(BTUH)	44,050	0
Annual Energy Demand/Cost		
Winter: Gas (cubic feet)	93,828($365.80)	30,777($327.63)
Fuel Oil (gallons)	710($129.53)	233($42.66)
Electricity(KWH)	23,157($428.51)	7,596($161.07)
Summer: (Air Conditioning)		
Electricity(KWH)	3,862($68.39)	0

The yearly cost of various forms of the required energy illustrates that gas was the cheapest form of energy at this location, and electricity was the most expensive. If electric energy were used for heating in this design more emphasis would be put on insulation.

However, as the table indicates, even the electricity cost in the buried house was higher than the gas cost in the surface house. With a dwindling gas supply and inflation, these costs will continue to increase.

When comparing the two houses on an annual cost basis, the buried house demonstrated an economic advantage. For the time value of money calculations, an eight percent interest rate and a 30-year mortgage life were used. The buried house was clearly favored by 3 to 1 even including the initial cost of the environmental equipment. These results are further summarized.

Table II
Annual Cost of Environmental Control Requirements

Using:	Gas	Fuel Oil	Electricity
Surface Design	$395	$459	$758
Underground Design	$120	$135	$283
Underground Compared to Surface Requirements	30%	29%	37%

The author has attempted to develop the non-economic and economic factors that should be considered in viewing an underground housing proposal.

An energy saving of 72% can be significant in reducing the costs of housing, particularly as future energy costs rise. Other aspects may be additionally significant in a particular setting where there are extreme temperatures or a close proximity to an airfield.

Should be seriously consider underground housing?

ENERGY CONSERVATION

(*Continued from page 6*)

advisor to the CNO (Military Construction), Investment Category 17 will be used to emphasize projects with high energy efficiency effects. With the very limited manpower and financial resources available, it will require program management at its trickiest to accomplish significant utilities conservation and alleviation of the energy crisis effects on fleet support.

Engineering Support

In support of this program technical expertise will be brought to bear on specific energy-sensitive problems. The Boiler Tune-Up (BTU) Program's objective is to improve all navy boiler efficiencies: an increase of just 5% in boiler efficiency would save over 4 x 10^{12} Btu of energy and approximately $3.5 million in heating costs alone. Equipment replacement projects and efficiency improvement-type projects such as repair and condensate-return which have been neglected in the past because of low rates of capital return must now be re-evaluated in the bright light of future energy costs. A project that was marginally attractive before may well be completely self-amortizing in a very short time, using the projected fuel cost trends. All utility rates will be rising due to skyrocketing fuel costs. In addition, the fuel cost increases require a fresh look at the feasibility of the "total energy" concept and waste-heat utilization equipment applications that were not attractive enough in the past to tap the limited construction funds.

Design Support

Some of the traditional design concepts of the past, developed during a period of cheap, abundant energy, must also be re-evaluated. Such design factors as insulation thickness, building configuration and materials standards are all related to the costs of operations and maintenance as well as capital investment. Design of cost-effective renovation as well as new construction standards will have to be investigated.

Trade-off comparisons between capital cost expenditures for new construction and modifications and operating maintenance expenses will have to be re-evaluated on a life-cycle basis using realistically accelerated energy cost projections.

Cost limitations must be reviewed to assure that they allow the additional insulation, etc., needed to reduce the energy consumption to some minimum standard.

It is imperative that minimum standards themselves be established. For the future, incorporation of newly developed waste heat usage devices and new energy sources into the navy system will demand more of the designer's time.

HEY FFFRED... WWWE'VE BEEN TAPPED AGAIN FOR A UNIT CITATION BBBY THE UTILITIES ENERGY CCCONSERVATION AAAACHOOOOO COMMITTEE

System Conservation

There are opportunities for utilities energy conservation at all points in the utility system. For example, the actual *energy source* may be changed to a more available supply. Effort at the point of utility *generation* can result in improved maintenance, increased existing equipment efficiency and replacement with more efficient generation equipment. *Transmission* losses may be reduced by such steps as insulation of steam lines, condensate return, installation of individual heating units and securing of long distribution lines and power factor correction of electrical systems.

"Waste heat" utilization plants may help control fuel costs.

Active usage curtailment promises the most effective energy conservation results at the domestic and industrial *end use level*. Personal conservation practices, load rescheduling, replacement of inefficient equipment, consolidation, building rehabilitation and mission usage curtailment, all would help.

But each of these actions requires effort and, in many cases, capital investment. The utilities engineers at the engineering field divisions will be doing their best to identify and help solve the individual problems, but we must remember that this resource is also in short supply.

Responsibility

The commanding officer of a naval station has the responsibility for maintaining the utility support capability necessary to enable him to accomplish his station mission. But we must all realize our responsibility to see that this mission is accomplished. The energy crisis will mean relatively hard times for the country as a whole. We can expect higher costs, a hotter summer, a colder winter, occasional blackouts and not being able to travel as often as in the past. But we in the navy must realize that the lack of utility support could mean a dangerously-lowered fleet defense capability. It is imperative that each of us do whatever we can to conserve utility energy through personal restraint before rationing becomes the only alternative.

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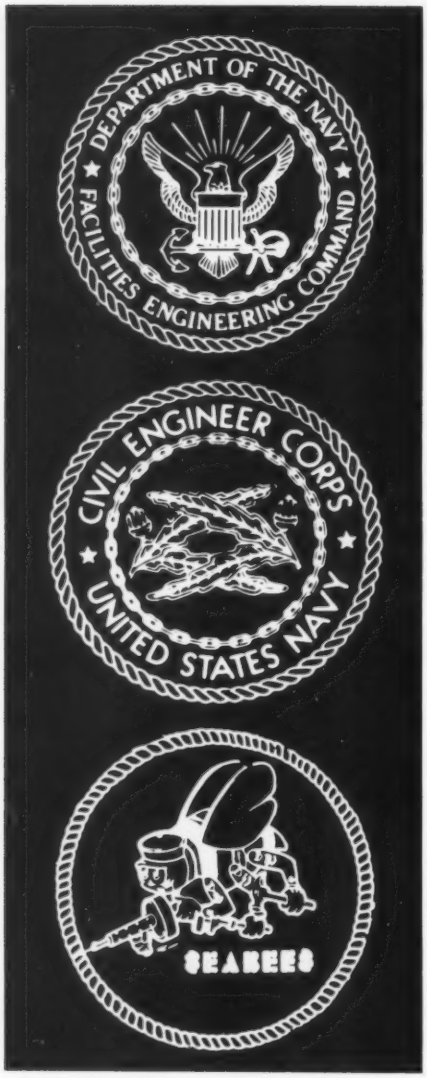

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